DOCUMENT RESUME

ED 301 648 CE 051 005

TITLE	Industrial Arts Instructional Tasks/Competencies for Metals Technology. Competency-Based Education.
INSTITUTION	Henrico County Public Schools, Glen Allen, VA. Virginia Vocational Curriculum Center.; James Madison Univ., Harrisonburg, Va.
SPONS AGENCY	Virginia State Dept. of Education, Richmond. Div. of Vocational and Adult Education.
PUB DATE	85
NOTE	153p.; For related documents, see CE 051 406 and CE 051 414.
AVAILABLE FROM	Virginia Vocational Curriculum and Resource Center, 2200 Mountain Road, Glen Allen, VA 23060-2208 ($8.57).
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01/PC07 Plus Postage.
DESCRIPTORS	Behavioral Objectives; *Competency Based Education; Course Content; Course Organization; Industrial Arts; Job Skills; Learning Activities; *Metals; *Metal Working; Postsecondary Education; Secondary Education; Shop Curriculum; State Curriculum Guides; *Task Analysis; Vocational Education
IDENTIFIERS	Virginia

ABSTRACT

This instructional task/competency package is designed to be used in combination with the "Industrial Arts Guide to CBE Implementation" in order to implement competency-based education (CBE) in the metals technology program in Virginia. The task/competency package contains suggested task sequence lists, content outlines, and task/competency information for the specific courses Metals Technology I and II. Part 1 of this publication contains a description of the industrial arts program and course descriptions, instructional task/competency lists, and content outlines for Metals Technology I and II. The task/competency lists include the minimum tasks/competencies identified for inclusion in the courses, listed in a suggested order of instruction. The content outlines correspond with the task/competency lists in content and sequencing. Part 2 contains information for instruction in each of the tasks/competencies in part 1. The following information is provided for each task/competency: appropriate program and course designation, performance and enabling objectives, a criterion-referenced measure, and suggested activities. A bibliography and list of audiovisual aids complete the document. (KC)

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Industrial Arts Instructional Tasks/Competencies for Metals Technology

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Department of Education
Vocational and Adult Education
Richmond, Virginia 23216

1985

Review Draft

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COMPETENCY-BASED CBE EDUCATION

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GUIDE APPLICATION

This guide has been prepared for use in developing and selecting instructional materials and in implementing competency-based education for the following program and courses:

Program	Course
INDUSTRIAL ARTS (CIP 21.0199)	METALS TECHNOLOGY I (VA 8349) METALS TECHNOLOGY II (VA 8442)

Additional information concerning the application and use of this guide in program planning and development may be obtained from:

Industrial Arts Service
Department of Education
P.O. Box 6Q
Richmond, Virginia 23216

INDUSTRIAL ARTS

INSTRUCTIONAL TASKS/COMPETENCIES

FOR

METALS TECHNOLOGY

Developed by

James Madison University

Produced by

Virginia Vocational Curriculum Center
Department of Vocational and Community Education
Henrico County Public Schools
Glen Allen, Virginia 23060

In Cooperation with
Industrial Arts Education
Department of Education
Vocational and Adult Education
Richmond, Virginia 23216

This guide was developed for the Virginia Department of Education, Division of Vocational and Adult Education, under the provision of a project grant #VA-83-C-133-1-IA-001.

1985

FOREWORD

Competency-based education (CBE) provides a means for allowing students and teachers to assess learning in relation to competencies and specific objectives set forth in advance.

Although nonoccupational in focus, this publication adheres to the CBE practice of recording competencies developed by students. This practice permits the smooth transition to an occupational track at a later time, if the student wishes.

Competency-based education is being implemented in Virginia to prepare students to enter the work force or to effect a smooth transition between secondary and postsecondary programs when both levels of education are required for career training. In addition, CBE is increasingly effective in retraining workers who have been displaced because of changing technology.

This publication will assist teachers and administrators in developing instructional materials that meet the needs of students and industry and comply with the Virginia CBE standards for vocational and adult education.

S. John Davis
Superintendent of Public Instruction

Melvin H. Garner
Administrative Director
Vocational and Adult Education

ACKNOWLEDGMENTS

The Industrial Arts Instructional Tasks/Competencies for Metals Technology was developed under the provisions of project grant #VA-80-C-133-1-IA-001. Dr. John W. Dickens, of James Madison University, served as project director and his contributions are gratefully acknowledged.

Dr. Kay Brown, Vocational Curriculum Development Supervisor, Virginia Department of Education, is recognized for coordinating the final publication process. The organizational and editorial revisions necessary to prepare the manuscript for publication were performed by the following staff members of the Virginia Vocational Curriculum Center, administered by Henrico County Public Schools, Department of Vocational and Community Education:

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Special appreciation is expressed to Dr. Arvid Van Dyke, Curriculum Specialist, James Madison University, for his aid in production of this guide.

Special recognition is given to the students of the Henrico Trade Center of the Henrico County Public Schools, Department of Vocational and Community Education. Under the supervision of William D. Burton, printing instructor, these students printed, assembled, packaged, and prepared the guide for distribution.

Dewey T. Oakley, Jr., Director
Division of Vocational Program Services
Virginia Department of Education

Thomas A. Hughes, Associate Director
Vocational Program Services for
Industrial Arts Education

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INTRODUCTION

This instructional task/competency package is designed to be used in combination with the Industrial Arts Guide to CBE Implementation in order to implement competency-based education in the Metals Technology I and II courses. The implementation guide contains information that pertains to all courses within the industrial arts area; the sections of that publication are titled Career Decision-Making Information, Student Organization (AIASA), Classroom Management Systems, and Recording Systems. This task/competency package contains suggested task sequence listings, content outlines, and task/competency information for the specific courses, Metals Technology I and II. Detailed instructions for combined use of these two publications are contained within the Industrial Arts Guide to CBE Implementation.

Using the Task/Competency Package

Part 1 contains a description of the Industrial Arts program and course descriptions, instructional task/competency lists, and content outlines for Metals Technology I and II. The task/competency list includes the minimum task/competencies identified for inclusion in the courses listed in a suggested order of instruction. The content outlines correspond with the task/competency lists in content and sequencing. However, within the outline, tasks are identified in topical form and related tasks are grouped into broader topics of instruction.

Part 2 contains information for instruction in each of the task/competencies identified in Part 1. The following information is provided for each task/competency: appropriate program and course designation, performance and enabling objectives, a criterion-referenced measure, and suggested activities and aids for instruction.

It is suggested that the Part 1 task sequence lists and course content outlines be reviewed initially so that any additional tasks may be added, any extraneous tasks may be deleted, and any desired changes in sequencing of instruction

be made. Once the sequencing is confirmed, lesson planning and implementation may proceed through referral to the Part 2 task/competency sheet noted beside each instructional topic within the outline.

PART 1

PROGRAMS AND COURSES

The course descriptions, content outlines, and suggested task sequences contained in this section were developed using the validated task inventory presented in Part 2 of this guide. The program and courses have been approved by the Virginia Department of Education.

The course outlines have been cross-referenced with the task/competency information sheets to assist the teacher in identifying instructional objectives, criterion standards, and audiovisual and reference materials.

OVERVIEW OF INDUSTRIAL ARTS EDUCATION PROGRAMS[1]

The Industrial Arts Education offerings are provided to assist the student in developing an understanding about industry and technology and in the discovery and development of individual potential. There are two types of industrial arts programs designed for the secondary school level:

1. Orientation and Exploration--designed for grades 7 through 9, this program assists students in making informed and meaningful occupational and educational choices. The program, designed for the middle or junior high school, provides the student with a broad base of try-out experiences and insights into career opportunities. It gives a basis for personal assessment of work interests and aptitudes. Instruction at this level places emphasis upon the following:

   a. Using the tools, equipment, materials, and products associated with industry and technology

   b. Role playing simulated enterprises associated with a number of the career clusters

   c. Studying and analyzing the materials, products, processes, problems, uses, developments, and contributions of many of the elements making up career clusters

   d. Studying the organization of numerous industries or businesses while experiencing typical aspects of many

   e. Researching, planning, designing, constructing, evaluating, and generalizing in association with problems and projects related to various career clusters.

2. Technical Adaptability--designed for grades 9 through 12, this program prepares students for vocational and technical career decisions. The senior high school program provides students with competencies which will result in an occupational readiness and responsible citizenship useful for the future craftsperson, technician, engineer, or consumer. It provides a foundation for career preparation either at the secondary or postsecondary level. The senior high program complements the middle or junor high school offering by completing a sequence of opportunities to learn about the industrial and technological aspects of society. Instruction in the program places emphasis upon the following:

   a. Preparing for enrollment in advanced technical or occupational programs

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[1]Division of Program Services and Division of Administrative Services and Continuing Education, Vocational Education Student Planning Guide (Richmond: Virginia Department of Education).

b. Understanding industry and technology and their place in society and the free enterprise system

c. Understanding industrial processes and the practical application of scientific principles

d. Developing basic skills in the proper use of common industrial tools, materials, and processes

e. Solving problems creatively, using the materials, processes, and products of industry.

Activities of the American Industrial Arts Student Association (AIASA) are included as a part of the instructional program to promote leadership qualities, high standards of work performance, scholarship, and safety. Teachers integrate AIASA experiences within their instruction by providing students with the following:

a. An involvement with the community's industrial and technical resources

b. Activities in parliamentary procedures and democratic decision-making

c. Recognition for exemplary performance, work skills, and safety procedures.

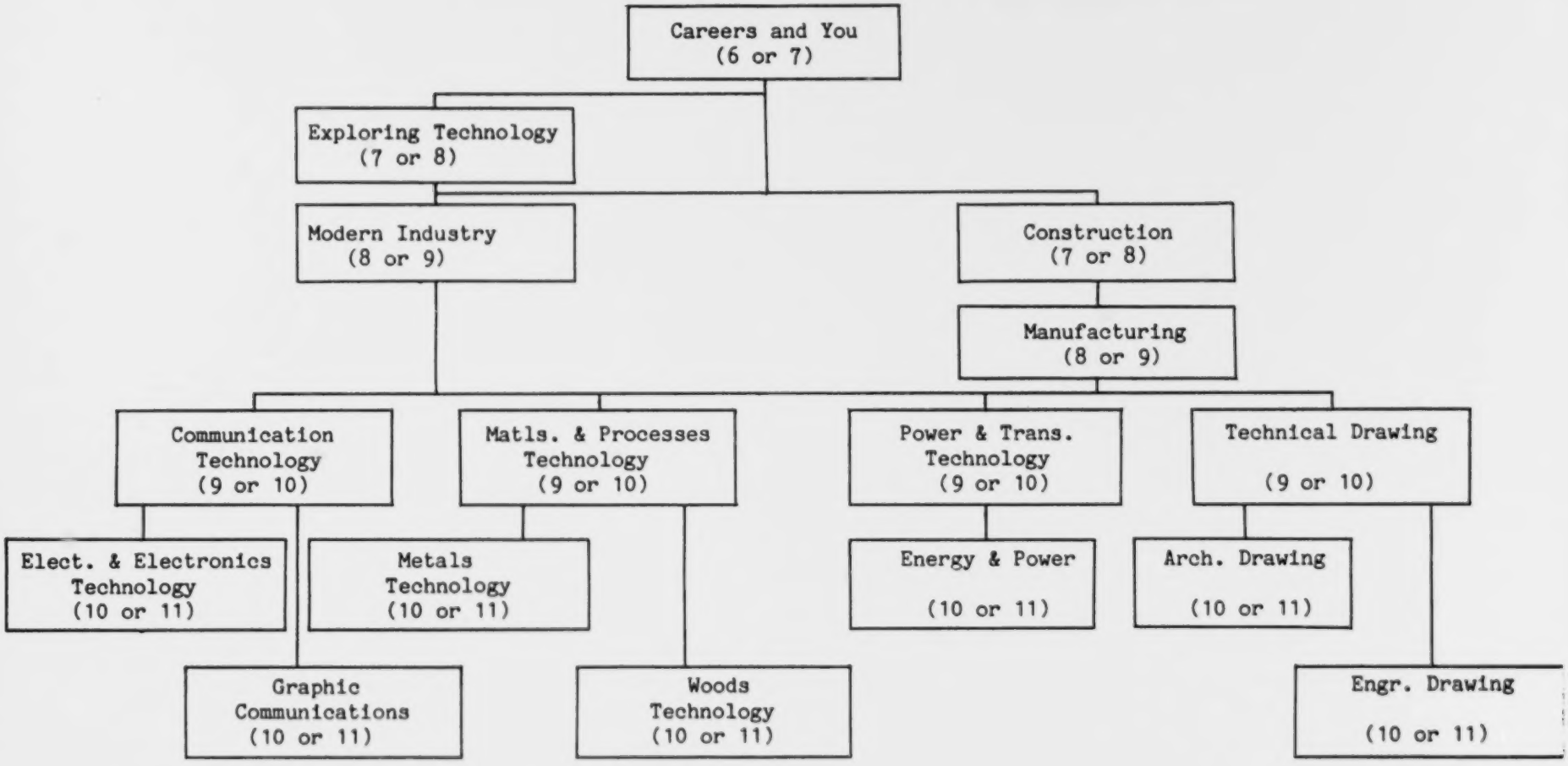
THE INDUSTRIAL ARTS CURRICULUM

LEVEL	GOAL	PROGRAM
Elementary School	Learning Reinforcement	Industrial Arts activities integrated within the elementary curriculum
Middle or Junior High School	Orientation and Exploration	Exploring Technology Modern Industry Construction Manufacturing
High School	Technical Adaptability	Phase I Basic Technical Drawing Communication Technology Materials and Processes Technology Power and Transporation Technology Phase II Architectural Drawing Electricity and Electronics Technology Energy and Power Engineering Drawing Graphic Communications Metals Technology Woods Technology

INDUSTRIAL ARTS EDUCATION PROGRAMS

PROGRAMS	AVAILABLE COURSES	CODE	SUGGESTED GRADE	NO. WEEKS
Occupational Orientation (Pre-exploratory)	A World of Choice: Careers and You	8475	6 or 7	36 or 18
Orientation and Exploration	Exploring Technology (18 or 36 weeks)	8464 8461	7, 8, or 9 7, 8, or 9	18 36
	Modern Industry (18 or 36 weeks)	8463 8462	7, 8, or 9 7, 8, or 9	18 36
	Construction (18 or 36 weeks)	8432 8431	7, 8, or 9 7, 8, or 9	18 36
	Manufacturing (18 or 36 weeks)	8426 8425	7, 8, or 9 7, 8, or 9	18 36
Technical Adaptability (Phase One)	Communication Technology	8415	9 or 10	36
	Materials and Processes Technology	8433	9 or 10	36
	Power and Transportation Technology	8445	9 or 10	36
	Basic Technical Drawing	8435	9 or 10	36
Technical Adaptability (Phase Two)	Architectural Drawing	8347	10 - 12	36
	Electricity & Electronics Technology	8416	10 - 12	36
	Energy and Power	8448	10 - 12	36
	Engineering Drawing	8436	10 - 12	36
	Graphic Communications	8458	10 - 12	36
	Metals Technology	8439	10 - 12	36
	Woods Technology	8449	10 - 12	36
Alternative Vocational Centers	Industrial Occupational Exploration (ICE)	8472	9 or 10	36

SUGGESTED SEQUENCES OF OFFERINGS*
INDUSTRIAL ARTS EDUCATION



*This chart is recommended for student guidance and is used to suggest best sequence of courses.

SECONDARY PROGRAM AND COURSES

PROGRAM TITLES: INDUSTRIAL ARTS--TECHNICAL ADAPTABILITY (Phase 2)

DESCRIPTION: This program provides students with competencies which will result in an occupational readiness and responsible citizenship for the future craftsperson, technician, engineer, or consumer. It provides a foundation for career preparation and a sequence of opportunities to learn about the industrial and technological aspects of society. Instruction in the program places emphasis upon the following:

- Preparation for enrollment in advanced technical or occupational programs
- The role of industry and technology in society and the free enterprise system
- Industrial processes and the practical application of scientific principles
- Skill development in the proper use of common industrial tools, materials, and processes
- Problem-solving and creativity involving the materials, processes, and products of industry.

CIP CODE 21.0199

SUGGESTED GRADE LEVEL: 10 - 12

APPROVED COURSE	VA COURSE CODE	DOT CODE/TITLE
Metals Technology Options	8439	N/A
Metals Technology I	8439	N/A
Metals Technology II	8442	

METALS TECHNOLOGY I (8439)

Description

Course Description: Metals Technology I is a one-period-a-day, 36-week laboratory course of the second-level senior high school technical program for students needing additional preparation before enrolling in an occupational program. Students design, plan, and build metal products as they study the metalworking industry. Students use both hand tools and power equipment to develop technical skills and an understanding of manufactured products and the fundamentals of metals technology.

Prerequisites: None

Suggested Grade Level: 10 - 12

Suggested Task/Competency Sequence

1.1 Identify characteristics of metalworking occupations
1.2 Identify personnel management systems used in metalworking industries
2.1 Identify safety equipment and rules used in the metalworking laboratory
2.2 Use laboratory tools and machines safely
2.3 Participate in an organized personnel system to manage class and laboratory activities
3.1 Participate in AIASA classroom leadership activities
3.2 Investigate community industrial and technical resources related to metals technology
3.3 Participate in school or community improvement activities
3.4 Participate in a group marketing enterprise
3.5 Plan and participate in contests and recognition events
4.1 Identify the composition of ferrous and non-ferrous metals
4.2 List the general characteristics of metals
4.3 Identify common metal stock
5.1 Select a metal product for a project
5.2 Sketch proposed metal project
5.3 Fill out a bill of materials
5.4 Complete product plan sheet
5.5 Prepare working drawings
6.1 Identify measuring and layout tools and terms
6.2 Determine size of metal stock
6.3 Measure and mark stock, using English and metric systems
7.1 Use hand hacksaw
7.2 Use cold chisels
7.3 Use files
7.4 Select bit and drill metal, using a hand-held drill

8.1 Cut sheet metal with hand tools
8.2 Shape sheet metal with hand tools
8.3 Use sheet metal forming machines
8.4 Use sheet metal bending machines
8.5 Use sheet metal cutting machines
9.1 Identify threaded fasteners
9.2 Fasten metal, using rivets
9.3 Thread metal rod and drilled holes
9.4 Solder metal, using appropriate fluxes and solder
10.1 Cast metal with sand casting techniques
10.2 Heat treat metals
10.3 Bend rod and bar stock
10.4 Forge metal
11.1 Spot weld sheet metal
11.2 Use an oxyacetylene welder
11.3 Use an electric arc welder
12.1 Use pedestal grinder
12.2 Turn metal with metal lathe
12.3 Operate drill press
13.1 Prepare metals for finishing
13.2 Apply finish to metal
13.3 Buff metal

METALS TECHNOLOGY I

	COURSE OUTLINE	CODE
I.	METALS TECHNOLOGY AND INDUSTRY EXPLORATION	
	A. Metalworking occupations characteristics	P1.1
	B. Personnel management systems	P1.2
II.	SAFETY AND LABORATORY MANAGEMENT SYSTEMS	
	A. Safety equipment and rules	P2.1
	B. Safe machine and tool use	P2.2
	C. Laboratory management activities	P2.3
III	STUDENT ORGANIZATION PARTICIPATION	
	A. AIASA leadership activities	P3.1
	B. Community resources	P3.2
	C. Improvement activities	P3.3
	D. Group marketing enterprise	P3.4
	E. Contests and recognition events	P3.5
IV.	METALS CHARACTERISTICS (BASIC)	
	A. Ferrous and non-ferrous metals	P4.1
	B. General characteristics	P4.2
	C. Common metal stock	P4.3
V.	METAL PRODUCTS (BASIC)	
	A. Project	P5.1
	B. Product sketch	P5.2
	C. Bill of materials	P5.3
	D. Product plan sheet	P5.4
	E. Working drawings	P5.5
VI.	LAYOUT AND MEASUREMENT	
	A. Tools and terms	P6.1
	B. Stock size	P6.2
	C. English and metric systems	P6.3
VII.	METALWORKING HAND TOOLS (BASIC)	
	A. Hacksaw	P7.1
	B. Cold chisels	P7.2
	C. Files	P7.3
	D. Drills	P7.4
VIII.	SHEET METAL HAND TOOLS	
	A. Cutting tools	P8.1
	B. Shaping tools	P8.2
	C. Forming machines	P8.3
	D. Bending machines	P8.4
	E. Cutting machines	P8.5
IX.	FASTENERS AND SOLDER (BASIC)	
	A. Threaded fasteners	P9.1
	B. Rivets	P9.2
	C. Threaded rod and drilled holes	P9.3
	D. Fluxes and solder	P9.4

X. METAL FORMING METHODS
- A. Sand casting technique — P10.1
- B. Heat treatment — P10.2
- C. Bending rod and bar stock procedures — P10.3
- D. Forging metal procedures — P10.4

XI. METAL WELDING METHODS (BASIC)
- A. Spot welding techniques — P11.1
- B. Oxyacetylene welding techniques — P11.2
- C. Electric arc welding techniques — P11.3

XII. MACHINE TOOLS (BASIC)
- A. Pedestal grinder — P12.1
- B. Metal lathe — P12.2
- C. Drill press — P12.3

XIII. METAL FINISHING PROCEDURES (BASIC)
- A. Preparation — P13.1
- B. Application — P13.2
- C. Buffing procedures — P13.3

METALS TECHNOLOGY II (8442)

Course Description

Metals Technology II is a one-period-a-day, 36-week laboratory course which prepares students for enrolment in advanced occupational preparation programs. Students design, plan, and make metal products, using machine tools, processes, and metal technology. Creativity is emphasized as students further develop their interests in metalworking or related areas of metals technology.

Prerequisites: Metals Technology I

Suggested Grade Level: 10 - 12

Suggested Task/Competency Sequence

1.3 Identify employment opportunities and trends in the metals industry
1.4 Complete career planning forms
2.1 Identify safety equipment and rules utilized in the metalworking laboratory
2.2 Use laboratory tools and machines safely
2.3 Particiipte in an organized personnel system to manage class and laboratory activities
3.1 Participate in AIASA classroom leadership activities
3.3 Participate in school or community improvement activities
3.4 Participate in a group marketing enterprise
3.5 Plan and participate in contests and recognition events
4.4 Describe the specific characteristics of various metals
5.1 Select a metal product for a project
5.2 Sketch a proposed metal product
5.3 Fill out a bill of materials
5.4 Complete product plan sheet
5.5 Prepare working drawings
6.1 Identify measuring and layout tools and terms
6.2 Determine size of metal stock
6.3 Measure and mark stock, using English and metric systems
7.1 Use hand hacksaw
7.2 Use cold chisels
7.3 Use files
7.4 Select bit and drill metal, using a hand-held drill
9.3 Thread metal rod and drilled holes
11.2 Use an oxyacetylene welder
11.3 Use an electric arc welder
12.1 Use pedestal grinder
12.2 Turn metal with metal lathe
12.4 Use milling machine
12.5 Use stock cutoff machines
12.6 Identify computer numerically controlled (CNC) machine tools
12.7 Identify electrical discharge, chemical, or other nontraditional machining processes
13.1 Prepare metals for finishing
13.2 Apply finish to metal
13.3 Buff metal

	COURSE OUTLINE	CODE
I.	METALS TECHNOLOGY AND INDUSTRY EXPLORATION	
	A. Employment opportunities	P1.3
	B. Career goals	P1.4
II.	SAFETY AND LABORATORY MANAGEMENT SYSTEMS*	
	A. Safety equipment and rules	P2.1
	B. Safe machine and tool use	P2.2
	C. Laboratory management activities	P2.3
III.	STUDENT ORGANIZATION PARTICIPATION*	
	A. AIASA leadership activities	P3.1
	B. Improvement activities	P3.3
	C. Group marketing enterprise	P3.4
	D. Contests and recognition events	P3.5
IV.	METALS CHARACTERISTICS (ADVANCED)	
	Specific characteristics	P4.4
V.	METAL PRODUCTS (ADVANCED)	
	A. Project	P5.1
	B. Product sketch	P5.2
	C. Bill of materials	P5.3
	D. Product plan sheet	P5.4
	E. Working drawings	P5.5
VI	LAYOUT AND MEASUREMENT*	
	A. Tools and terms	P6.1
	B. Stock size	P6.2
	C. English and metric systems	P6.3
VII.	METALWORKING HAND TOOLS (ADVANCED)	
	A. Hacksaw	P7.1
	B. Cold chisels	P7.2
	C. Files	P7.3
	D. Drill	P7.4
VIII.	FASTENERS AND SOLDER (ADVANCED)	
	Metal rod and drilled holes	P9.3
IX.	METAL WELDING METHODS (ADVANCED)	
	A. Oxyacetylene welding techniques	P11.2
	B. Electric arc welding techniques	P11.3
X.	MACHINE TOOLS (ADVANCED)	
	A. Pedestal grinder (review)	P12.1
	B. Metal lathe (review)	P12.2
	C. Milling machine	P12.4
	D. Cutoff machines	P12.5
	E. Computer numerically controlled machine tools	P12.6
	F. Nontraditional machining processes	P12.7
XI.	METAL FINISHING PROCEDURES (ADVANCED)	
	A. Preparation	P13.1
	B. Application	P13.2
	C. Buffing procedures	P13.3

*On-going competencies

PART 2

TASK INVENTORY

One of the major characteristics of competency-based education (CBE) is that the course content is based upon actual jobs or tasks performed by persons living and working in the technological world. In Virginia, the Department of Education has established standards for competency-based education. According to these standards, competencies must be "role-relevant" and based upon "appropriate research." This standard states:

> Role-relevant competencies that include standards are identified and stated:
>
> The competencies with standards will be identified through V-TECS, IDECC, and other appropriate research. Advisory committees should be used to review competencies and standards. Competencies in the affective domain will be included. Role-relevant competencies for occupational preparation programs are those that specifically relate to the occupation for which the student is being prepared as well as to the personal needs of the student. Role-relevant competencies are related also to orientation, exploration, or industrial arts experiences which have been identified for students.

Therefore, "role-relevant" jobs or tasks, called competencies in CBE, must be identified and validated before instructional materials are developed and subsequent instruction can take place.

The task list contained in this instructional guide was based on the following:

1. The Virginia Industrial Arts Education guide, A Catalog of Tasks for Competency-Based Instruction in Metals Technology I and II
2. The review and selection of appropriate competency-based materials
3. Input from industrial arts teachers and curriculum specialists.

Based upon the information collected and reviewed from the available sources indicated, a task inventory was prepared.

The next major step involved in the development of the task inventory was validation of the task list. Validation is essential if the information collected is to be useful in operating CBE courses and programs. The validation process

involved the following:

1. Review by writing team members to determine completeness of the inventory
2. Review and validation by state consultants to ensure the role-relevance and completeness of the inventory
3. Review by local industrial arts teachers to determine the validity of the inventory
4. Final review and editing by writing team members, project directors, and state staff.

The task list included in this publication was based on the current available resources and validated by teachers, advisory committee members, and persons employed in industrial arts. Regional and local tasks were included in the inventory; therefore, individual tasks may or may not be applicable for a given locality. It is essential that all instruction be based on the validated task analyses included in this resource.

The task list has not been arranged in order of difficulty of tasks or instructional sequence because of the variety of courses and programs offered throughout the state. Sequencing has been shown in the sample course outlines in Part 1 of this package.

TASK INVENTORY FOR

METALS TECHNOLOGY

CONTENT/CONCEPT AREAS

1. Exploring Metals Technology and Industry
2. Organizing Safety and Laboratory Management Systems
3. Participating in the Student Organization Throughout the Course
4. Describing Characteristics of Metals
5. Planning and Designing Metal Products
6. Measuring and Laying Out Work
7. Using Metalworking Hand Tools
8. Using Sheet Metal Tools
9. Using Fasteners and Solder
10. Forming Metal
11. Welding Metal
12. Using Machine Tools
13. Finishing Metal

CONTENT/CONCEPT

1. EXPLORING METALS TECHNOLOGY AND INDUSTRY

TASKS/COMPETENCIES

1.1. Identify characteristics of metalworking occupations

1.2 Identify personnel management systems used in metalworking industries

1.3 Identify employment opportunities and trends in the metals industry

1.4 Complete career planning forms

Application

CONTENT/CONCEPT

1. EXPLORING METALS TECHNOLOGY AND INDUSTRY

TASK/COMPETENCY

1.1 Identify characteristics of metalworking occupations

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology I (8439)

1.1

PERFORMANCE OBJECTIVE

P1.1 Given resource materials, identify characteristics of three metalworking occupations in a written report. To be acceptable the report must include the following information: nature of the work performed, education required, job availability, advancement opportunities, working conditions, average salary, and fringe benefits for each occupation.

SELECTED ENABLING OBJECTIVES

E1.1.1 Locate and identify metalworking occupations in the Dictionary of Occupational Titles and The Occupational Outlook Handbook.

E1.1.2 Explain the following work modes: mechanical, social, investigative, conventional, creative, and persuasive.

E1.1.3 Relate work modes to specific metalworking occupations.

E1.1.4 Outline the function of the apprenticeship program in selected metals technology occupations.

CRITERION-REFERENCED MEASURE

C1.1 Written report, identifying characteristics of three metalworking occupations, to contain information on the nature of the work performed, education required, job availability, advancement opportunities, working conditions, average salary, and fringe benefits of each occupation.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students identify various metalworking occupations and select three occupations in which they are interested (E1.1.1).
2. Demonstrate how to use the Dictionary of Occupational Titles and Occupational Outlook Handbook to locate needed information. Explain how to determine worker relationships to data, people, and things, using the D.O.T. occupational code (E1.1.1).
3. Explain the concept of work modes, and have students describe an occupation in terms of work modes (E1.1.2, E1.1.3).
4. Explain how the apprenticeship program works in various occupations related to metals technology (E1.1.4).
5. Have students give an oral report on their research. The written report can be used to make an outline for the oral report (E1.1.1-E1.1.4).

SELECTED TOOLS AND MATERIALS

Resource materials

SELECTED AUDIOVISUAL MATERIALS

Films: Apprenticeship Training (05305). Audiovisual Services.
Careers in Machine Trades (81012). Audiovisual Services.
The Toolmaker's Art (54910). Audiovisual Services.

Filmstrips: Metalworking Series. Career Aids, Inc. Titles: (1) Overview (2) Machinist (3) Sheet Metal Worker (4) Welder (5) Electroplater (6) Foundry Worker.

SELECTED REFERENCES

Dictionary of Occupational Titles. U.S. Department of Labor.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.
Occupational Outlook Handbook. U.S. Department of Labor.

Application

CONTENT/CONCEPT

1. EXPLORING METALS TECHNOLOGY AND INDUSTRY

TASK/COMPETENCY

1.2 Identify personnel management systems used in metalworking industries

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology I (8439)

1.2

PERFORMANCE OBJECTIVE

P1.2 Given handouts and background information, identify personnel management systems used in metalworking industries on a written test with 80% accuracy.

SELECTED ENABLING OBJECTIVES

E1.2.1 List various positions in personnel management systems.

E1.2.2 Describe activities or duties of each person in a personnel management system.

E1.2.3 Explain which personnel management system is found most frequently in the local community in metalworking industries or businesses.

CRITERION-REFERENCED MEASURE

C1.2 Personnel management systems in metalworking industries identified on a written test with 80% accuracy.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Prepare a handout listing the various types of personnel management systems (E1.2.1).

2. Show audiovisuals which illustrate personnel in metal-related industries (E1.2.2).

3. Arrange for students to visit a local metalworking business to examine the personnel management system in use (E1.2.2).

4. Invite a local personnel manager to speak to the class about various management systems (E1.2.1-E1.2.3).

SELECTED TOOLS AND MATERIALS

Handouts: Personnel management systems
Instructor-prepared test

SELECTED AUDIOVISUAL MATERIALS

Film: Careers in Machine Trades (81012). Audiovisual Services.

SELECTED REFERENCES

None identified

Application

CONTENT/CONCEPT

1. EXPLORING METALS TECHNOLOGY AND INDUSTRY

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

1.3 Identify employment opportunities and trends in the metals industry

COURSE

Metals Technology II (8442)

1.3

PERFORMANCE OBJECTIVE

P1.3 Given resource materials, identify employment opportunities and trends in the metals industry by preparing a chart or bulletin board in accordance with instructor guidelines.

SELECTED ENABLING OBJECTIVES

E1.3.1 List sources of occupational information describing the metals industry.

E1.3.2 Outline methods to use to obtain information.

E1.3.3 Design a bulletin board or chart to display information on various metal-working occupations.

CRITERION-REFERENCED MEASURE

C1.3 Chart or bulletin board identifying metals industry employment opportunities prepared in accordance with instructor guidelines.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students examine the Occupational Outlook Handbook, newspapers, trade magazines, and other sources for relevant occupational information (E1.3.1).

2. Have students prepare letters to trade associations requesting career information (E1.3.2).

3. Have students prepare a "Wall of Opportunity" bulletin board displaying the occupational information gathered (E1.3.3).

4. Combine this task with an open-house for elementary, junior high, senior high, or adult visitors to increase occupational awareness about the metals industry (E1.3.1-E1.3.3).

SELECTED TOOLS AND MATERIALS

Bulletin board
Help-wanted ads (newspapers and trade magazines)
Newspaper articles
Handout: Instructor-prepared guidelines

SELECTED AUDIOVISUAL MATERIALS

Film: Apprenticeship Training (05305). Audiovisual Services.
Computer: Virginia VIEW Career Search. Virginia Occupational Information Coordinating Committee.

SELECTED REFERENCES

Occupational Outlook Handbook. U.S. Department of Labor.

Application

CONTENT/CONCEPT

1. EXPLORING METALS TECHNOLOGY AND INDUSTRY

TASK/COMPETENCY

1.4 Complete career planning forms

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology II (8442)

1.4

PERFORMANCE OBJECTIVE

P1.4 Given exploratory experiences in the Metals Technology Course, complete a career planning form to reflect current occupational and educational decisions. Planning form must be completed in accordance with guidelines provided by instructor.

SELECTED ENABLING OBJECTIVES

E1.4.1 Identify the occupational and educational training needs of various occupations in the metals industry.

E1.4.2 Describe tentative career goals and strategies for meeting those goals.

E1.4.3 List persons or institutions that can provide employment or education consistent with personal goals.

CRITERION-REFERENCED MEASURE

C1.4 Career planning form completed in accordance with instructor-provided guidelines.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students complete occupational interest surveys or other career guidance materials and discuss the results in relationship to specific occupations (E1.4.1).

2. Assist students in contacting persons, institutions, or businesses that can provide occupational or educational assistance (E1.4.3).

3. Invite a guidance counselor to speak to class about planning career goals (E1.4.3).

SELECTED TOOLS AND MATERIALS

Handouts: Career planning form
Instructor-prepared guidelines

SELECTED AUDIOVISUAL MATERIALS

Computer: Virginia VIEW Career Search. Virginia Occupational Information Coordinating Committee.

SELECTED REFERENCES

None identified

CONTENT/CONCEPT

2. ORGANIZING SAFETY AND LABORATORY MANAGEMENT SYSTEMS

TASKS/COMPETENCIES

2.1 Identify safety equipment and rules used in the metalworking laboratory

2.2 Use laboratory tools and machines safely

2.3 Participate in an organized personnel system to manage class and laboratory activities

Application

CONTENT/CONCEPT

2. ORGANIZING SAFETY AND LABORATORY MANAGEMENT SYSTEMS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

2.1 Identify safety equipment and rules used in the metalworking laboratory

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

2.1

PERFORMANCE OBJECTIVE

P2.1 Given a handout of safety rules and a demonstration of the operation of safety equipment, identify safety equipment and rules used in the metalworking laboratory by scoring 100% on a written or performance test given by the instructor.

SELECTED ENABLING OBJECTIVES

E2.1.1 State safety rules and identify safety equipment applicable to the metalworking laboratory.

E2.1.2 Identify specific unsafe or hazardous situations that may occur in the metalworking laboratory.

E2.1.3 Relate safety equipment associated with the laboratory to its proper usage for a particular situation.

E2.1.4 Distinguish among class A, B, and C fire extinguishers and the materials that each type will extinguish.

E2.1.5 Determine adequate eye, foot, ear, hand, face, or body protection required by various operations performed in the laboratory.

CRITERION-REFERENCED MEASURE

C2.1 Safety equipment and rules identified on a written or performance test with 100% accuracy.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students read resource materials identifying the general safety rules and safety equipment required for a safe working environment (E2.1.1-E2.1.5).
2. Provide students with a copy of laboratory safety rules and describe (E2.1.1).
3. Have students practice safety rules in the laboratory each day (E2.1.1-E2.1.5).
4. Form a safety committee to inspect the laboratory on a periodic basis and to arrange special safety events such as outside speakers (E2.1.1-E2.1.5).
5. Explain the color coding of fire extinguishers (green, red, blue) and explain how each type of fire extinguisher is used (E2.1.4).

SELECTED TOOLS AND MATERIALS

Handout: Laboratory safety rules
Personal protective devices (safety glasses, shoes, aprons, welding helmets, goggles, gloves).
Shop tools and equipment for safety (fire extinguishers, fire blankets, storage for combustibles, safety rules and posters, machine and belt guards).

SELECTED AUDIOVISUAL MATERIALS

Films: Safety in the Shop - Basic Practices (37310). Audiovisual Services.
School Shop Safety (20609). Audiovisual Services.
We'll See Tomorrow (52006). Audiovisual Services.
Filmstrip: Introduction to Machine/Metal Shop Safety. Abraxas.
Videotape: I.A. for the 70's, Program 2- It's Better to be Safe than Sorry (27290). Audiovisual Services.

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalworking Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

2. ORGANIZING SAFETY AND LABORATORY MANAGEMENT SYSTEMS

TASK/COMPETENCY

2.2 Use laboratory tools and machines safely

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

2.2

PERFORMANCE OBJECTIVE

P2.2 Given metalworking laboratory equipment and the proper safety instructions for each tool and machine, use laboratory tools and machines safely in accordance with accepted industrial safety standards. All safety precautions listed in the operator's manuals must be followed.

SELECTED ENABLING OBJECTIVES

E2.2.1 Identify specific safety rules and equipment as they apply to each tool or machine in the metalworking laboratory.

E2.2.2 Demonstrate the use of safety equipment as it applies to each tool or machine.

E2.2.3 Explain how to operate each tool or machine in a safe manner.

CRITERION-REFERENCED MEASURE

C2.2 Laboratory tools and machines used safely in accordance with accepted industrial safety standards. All safety precautions listed in operator's manuals followed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students read about each piece of equipment in the laboratory, especially noting the safety precautions (E2.2.1).

2. Give demonstration, audiovisual presentation, or written materials on safety rules and equipment as they apply to each tool or machine and to specific tasks (E2.2.2).

3. Have students orally explain the safety procedures to be used in operating a piece of equipment (E2.2.3).

4. Have each student complete a written safety test with 100% accuracy for each piece of equipment before use (E2.2.1-E2.2.3).

SELECTED TOOLS AND MATERIALS

Handouts: Safety tests on each machine in laboratory (example: squaring shear)
Operator's manuals

SELECTED AUDIOVISUAL MATERIALS

Films: ABC of Hand Tools - Part I (20810). Audiovisual Services.
ABC of Hand Tools - Part II (20910). Audiovisual Services.
Playing It Safe With Power Tools (06010). Audiovisual Services.
Safety in the Shop - Hand Tools (37210). Audiovisual Services.
Safety in the Shop - Power Tools (37010). Audiovisual Services.

Filmstrips: Metal Shop Safety Series. Bergwall. Titles: (1) Protective Clothing and Good Hand Tool Practices (2) Working with Power Tools and Machines.

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalworking Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

2. ORGANIZING SAFETY AND LABORATORY MANAGEMENT SYSTEMS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

2.3 Participate in an organized personnel system to manage class and laboratory activities

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

2.3

PERFORMANCE OBJECTIVE

P2.3 Given a list of in-class officers, committees, and the duties of each, participate in an organized personnel system for the class so that classroom and laboratory activities are managed in accordance with the appropriate AIASA guide.

SELECTED ENABLING OBJECTIVES

E2.3.1 Explain the need for people to have organizations.

E2.3.2 List names of organizations in school, community, and industry.

E2.3.3 Describe duties of officers and committees for this class.

E2.3.4 Apply for a position in the personnel system and on a committee such as the "Safety Committee."

E2.3.5 Follow in-class agenda to conduct meetings.

CRITERION-REFERENCED MEASURE

C2.3 Organized personnel system participated in as prescribed in the appropriate AIASA guide.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Introduce students to the American Industrial Arts Student Association through literature and slides (E2.3.1).
2. Present lesson on organizing personnel systems from AIASA Guide 2 (E2.3.2).
3. Hand out and discuss a listing of the duties of officers and committees in the personnel system (E2.3.3, E2.3.4).
4. Show film or videotape on meeting procedures (E2.3.5).
5. Explain organizational chart in which each leader and committee are identified (E2.3.3, E2.3.4).
6. Use class safety committee to emphasize safety in the laboratory (E2.3.6).

SELECTED TOOLS AND MATERIALS

Flag and banner
Gavel
Officer symbols on table in front of class area

SELECTED AUDIOVISUAL MATERIALS

Film: How to Conduct a Meeting. Audiovisual Services.
Slides: Move with Tomorrow. Industrial Arts Education Service.
Organizing the Industrial Arts Student Association. Industrial Arts Education Service.
Videotapes: In-Class AIASA Management. Industrial Arts Education Service.

SELECTED REFERENCES

Organizing the Industrial Arts Student Association, Guide 1. Virginia Department of Education.
Robert's Rules of Order. Robert.
Student Association Activities in Industrial Arts, Guide 2. Virginia Department of Education.

CONTENT/CONCEPT

3. PARTICIPATING IN THE STUDENT ORGANIZATION THROUGHOUT THE COURSE

TASKS/COMPETENCIES

3.1 Participate in AIASA classroom leadership activities

3.2 Investigate community industrial and technical resources related to metals technology

3.3 Participate in school or community improvement activities

3.4 Participate in a group marketing enterprise

3.5 Plan and participate in contests and recognition events

Application

CONTENT/CONCEPT

3. PARTICIPATING IN THE STUDENT ORGANIZATION THROUGHOUT THE COURSE

TASK/COMPETENCY

3.1 Participate in AIASA classroom leadership activities

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

3.1

PERFORMANCE OBJECTIVE

P3.1 Given resources, teacher guidance, and the opportunity, participate in AIASA classroom leadership activities in accordance with the suggestions found in various AIASA guides.

SELECTED ENABLING OBJECTIVES

E3.1.1 Identify and describe goals of the AIASA.

E3.1.2 Define and list duties of class president, secretary, treasurer, reporter, sergeant-at-arms, parlimentarian, and historian.

E3.1.3 Participate as officer or voting member in democratic classroom decision-making activities.

CRITERION-REFERENCED MEASURE

C3.1 AIASA classroom leadership activities participated in as described in AIASA guides.

SELECTED INSTRUCTIONAL ACTIVITIES

1. List and discuss the goals of AIASA. Provide students with background on the local, state, and national organization (E3.1.1).

2. Have students organize class for association activities. Supervise election of class officers and discuss duties of officers and members (E3.1.2).

3. Review parliamentary procedure as necessary and serve in an advisory capacity during group meetings (E3.1.3).

4. Display association seal, motto, and goals on classroom bulletin board (E3.1.1).

SELECTED TOOLS AND MATERIALS

Officer symbols
Banner
Notebooks

SELECTED AUDIOVISUAL MATERIALS

Films: Art of Communication: Aids to Speaking (28808). Audiovisual Services.
Art of Communication: How to Conduct a Meeting (21908). Audiovisual Services.
TV Tape: In-Class AIASA Management. Industrial Arts Education Service.
Slides: Move With Tomorrow. Industrial Arts Education Service.
AIASA--A Classroom Experience. National AIASA.

SELECTED REFERENCES

Student Association Activities in Industrial Arts Instruction. Industrial Arts Education Service.

Application

CONTENT/CONCEPT

3. PARTICIPATING IN THE STUDENT ORGANIZATION THROUGHOUT THE COURSE

TASK/COMPETENCY

3.2 Investigate community industrial and technical resources related to metals technology

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology I (8439)

3.2

PERFORMANCE OBJECTIVE

P3.2 Given resources and an opportunity to participate in AIASA classroom activities, participate in a class-planned activity to investigate community and technical resources in accordance with student organization guidelines.

SELECTED ENABLING OBJECTIVES

E3.2.1 Serve on committee to identify possible community and technical resources to investigate.

E3.2.2 List and explain factors involved in successful planning for a field trip or guest speaker.

E3.2.3 Participate in committee or class activities to select a possible classroom speaker or to plan a class field trip.

E3.2.4 Prepare safety posters for local metals-related industry.

CRITERION-REFERENCED MEASURE

C3.2 Community and technical resources investigation participated in according to student organization guidelines.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Assist students and class committee in identifying possible community and technical resources to investigate as a student organization project (E3.2.1).

2. Discuss factors involved in successful planning for a field trip or guest speaker (E3.2.2)

3. Have students invite speakers from industry to discuss topics of interest or to give special demonstrations. Involve students in selecting and planning field trips (E3.2.3).

4. Offer students credit for safety posters they make for local metals industry (E3.2.4).

SELECTED TOOLS AND MATERIALS

Directories listing local industries
Supplies for creating posters

SELECTED AUDIOVISUAL MATERIALS

Videotapes: I.A. for the 70's, Program 13 - From Beginning to End (30890). Audiovisual Services.
I.A. for the 70's, Program 14 - From Here It Goes To (30890). Audiovisual Services.

SELECTED REFERENCES

Student Association Activities in Industrial Arts Instruction. Industrial Arts Education Service.

Application

CONTENT/CONCEPT

3. PARTICIPATING IN THE STUDENT ORGANIZATION THROUGHOUT THE COURSE

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

3.3 Participate in school or community improvement activities

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

3.3

PERFORMANCE OBJECTIVE

P3.3 Given the resources and an opportunity to participate in AIASA classroom activities, participate in class-planned community or school improvement activity in accordance with student organization guidelines.

SELECTED ENABLING OBJECTIVES

E3.3.1 List and describe possible school or community improvement projects.

E3.3.2 List and explain factors to consider when planning and carrying out successful group projects.

E3.3.3 Select a community or school improvement project, determine tasks to be done, and determine duties and responsibilities of class members.

CRITERION-REFERENCED MEASURE

C3.3 Community or school improvement activity participated in according to student organization guidelines.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Help students identify possible school or community improvement projects (E3.3.1).

2. Discuss factors to consider when planning and carrying out successful group projects (E3.3.2).

3. Help students select, plan, implement, and evaluate a school or community improvement project (E3.3.3).

4. Help AIASA students manage a metals repair service for school personnel (E3.3.3).

SELECTED TOOLS AND MATERIALS

Directories of local service and social agencies in community

SELECTED AUDIOVISUAL MATERIALS

None identified

SELECTED REFERENCES

Student Association Activities in Industrial Arts Instruction. Industrial Arts Education Service.

Application

CONTENT/CONCEPT

3. PARTICIPATING IN THE STUDENT ORGANIZATION THROUGHOUT THE COURSE

TASK/COMPETENCY

3.4 Participate in a group marketing enterprise

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

3.4

PERFORMANCE OBJECTIVE

P3.4 Given resources, tools, equipment, supplies, and an opportunity to participate in AIASA classroom activities, participate in a group marketing enterprise project in accordance with student organization guidelines.

SELECTED ENABLING OBJECTIVES

E3.4.1 Identify possible marketing enterprise projects suitable for a classroom student organization.

E3.4.2 List factors to consider when planning and implementing a group marketing enterprise project.

E3.4.3 Select a group marketing enterprise project, determine tasks to be done, and determine duties of class members.

CRITERION-REFERENCED MEASURE

C3.4 Group marketing enterprise participated in according to student organization guidelines.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Help students identify possible marketing enterprise projects. Share previous project experiences (E3.4.1).

2. Discuss factors to consider when planning and implementing a group marketing enterprise project. Include mass production techniques (E3.4.2).

3. Help students plan, organize, implement, and evaluate a group marketing enterprise project (E3.4.3).

SELECTED TOOLS AND MATERIALS

None identified

SELECTED AUDIOVISUAL MATERIALS

Videotapes:

I.A. for the 70's, Program 4, Let's Make Money for Everyone (30290). Audiovisual Services.

I.A. for the 70's, Program 5, You've Got to be Organized (30390). Audiovisual Services.

I.A. for the 70's, Program 6, If We Do It Like This (30490). Audiovisual Services.

I.A. for the 70's, Program 7, Why Didn't We Think of That (30590). Audiovisual Services.

I.A. for the 70's, Program 26 - Will It Work - Will it Sell. Audiovisual Services.

SELECTED REFERENCES

Machine Shop Projects. Roy E. Knight.

Student Association Activities in Industrial Arts Instruction. Industrial Arts Education Service.

Application

CONTENT/CONCEPT

3. PARTICIPATING IN THE STUDENT ORGANIZATION THROUGHOUT THE COURSE

TASK/COMPETENCY

3.5 Plan and participate in contests and recognition events

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

3.5

PERFORMANCE OBJECTIVE

P3.5 Given resources, the necessary tools, equipment, materials, and an opportunity to participate in AIASA classroom activities, plan and/or participate in a local, state, or national competition in accordance with school policies and student organization guidelines.

SELECTED ENABLING OBJECTIVES

E3.5.1 Examine types and purposes of competitions. Identify standards for achievement in craft, performance, and safety.

E3.5.2 Examine or establish procedures and rules for a contest.

E3.5.3 Determine skills or qualifications necessary to enter a competition.

E3.5.4 Determine how achievements will be recognized or regarded after the competition.

E3.5.5 Enter and/or conduct a competition in class.

CRITERION-REFERENCED MEASURE

C3.5 Competitions participated in according to school policy and student organization guidelines.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Discuss types and purposes of competitions (E3.5.1).

2. Display sample contest entry forms and rules. Discuss competition procedures and skills or qualifications needed to enter designated competition (E3.5.2, E3.5.3).

3. Discuss ways achievement is rewarded or recognized in competitions (E3.5.4).

4. Help students enter and/or conduct a local competition (E3.5.5).

SELECTED TOOLS AND MATERIALS

Handouts: Sample contest entry forms and rules

SELECTED AUDIOVISUAL MATERIALS

Films: Art of Communication - Aids to Speaking (28808). Audiovisual Services.
Art of Communication - How to Conduct a Meeting (21908). Audiovisual Services.

Slides: Previous contests or competitions, if available

SELECTED REFERENCES

AIASA--Competitive Event Guidelines. National AIASA.
Standards for AIASA Events. Industrial Arts Education Service.
Student Association Activities in Industrial Arts Instruction. Industrial Arts Education Service.

CONTENT/CONCEPT

4. DESCRIBING CHARACTERISTICS OF METALS

TASKS/COMPETENCIES

4.1 Identify the composition of ferrous and non-ferrous metals

4.2 List the general characteristics of metals

4.3 Identify common metal stock

4.4 Describe the specific characteristics of various metals

Application

CONTENT/CONCEPT

4. DESCRIBING CHARACTERISTICS OF METALS

TASK/COMPETENCY

4.1 Identify the composition of ferrous and non-ferrous metals

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology I (8439)

4.1

PERFORMANCE OBJECTIVE

P4.1 Given resource materials on the composition of metals, identify the composition of various ferrous and non-ferrous metals on an instructor-prepared test with 90% accuracy.

SELECTED ENABLING OBJECTIVES

E4.1.1 Distinguish between ferrous and non-ferrous metals.

E4.1.2 List examples of ferrous metals and describe their primary chemical contents.

E4.1.3 List examples of non-ferrous metals and describe primary chemical contents.

E4.1.4 Explain the terms element, compound, and alloy.

CRITERION-REFERENCED MEASURE

C4.1 Composition of ferrous and non-ferrous metals identified with 90% accuracy on an instructor-prepared test.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Prepare a handout in chart format outlining the information students are to collect on each ferrous and non-ferrous metal (E4.1.1 - E4.1.4).

2. Have students use resource materials to complete the handout provided (E4.1.1-E4.1.3).

3. Discuss terms unique to the composition of metals (E4.1.4).

SELECTED TOOLS AND MATERIALS

Handouts: Ferrous and non-ferrous metals chart
Instructor-prepared test

SELECTED AUDIOVISUAL MATERIALS

Films: Copper (02012). Audiovisual Services
Tungsten (47608). Audiovisual Services.

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT	PROGRAM
4. DESCRIBING CHARACTERISTICS OF METALS	INDUSTRIAL ARTS (21.0199)
TASK/COMPETENCY	**COURSE**
4.2 List the general characteristics of metals	Metals Technology I (8439)

4.2

PERFORMANCE OBJECTIVE

P4.2 Given descriptions of several metals, list the general characteristics of metals on an instructor-prepared test with 90% accuracy.

SELECTED ENABLING OBJECTIVES

E4.2.1 Describe how metals have chemical, physical, and mechanical properties.

E4.2.2 Determine which metals are the most corrosion resistant.

E4.2.3 Define the following physical properties of metals: color, density, weight, and electrical and heat conductivity.

E4.2.4 Define the following mechanical properties of metals: hardness, hardenability, brittleness, ductility, malleability, toughness, machinability, and fusibility.

E4.2.5 Explain the terms strength, elasticity, and fatigue.

CRITERION-REFERENCED MEASURE

C4.2 The general characteristics of metals listed on an instructor-prepared test with 90% accuracy.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Discuss the differences between chemical, physical, and mechanical properties. Prepare a demonstration that illustrates these differences (E4.2.1).

2. Have students bring in examples of corrosion resistant and noncorrosion resistant metals (E4.2.2).

3. Have students formulate an example that illustrates each term in the physical and mechanical properties of metals (E4.2.3, E4.2.4).

4. Demonstrate tensile, compressive, shear, and torsional strength of a particular metal (E4.2.5).

SELECTED TOOLS AND MATERIALS

Handout: Instructor-prepared test

SELECTED AUDIOVISUAL MATERIALS

Film: Steel and America (90312). Audiovisual Services.

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

4. DESCRIBING CHARACTERISTICS OF METALS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

4.3 Identify common metal stock

COURSE

Metals Technology I (8439)

4.3

PERFORMANCE OBJECTIVE

P4.3 Given samples of metal stock, identify each sample of common metal stock. Ninety percent of the following must be identified correctly on an instructor-prepared test: hexagonal and octagonal bar, round bar, square bar, structural shapes (angle, channel, tee, I beam), tubing (round, square), and sheets of galvanized steel, galvanized sheet iron, tin plate, black iron, copper, aluminum, and stainless steel.

SELECTED ENABLING OBJECTIVES

E4.3.1 List names of common metal stock.

E4.3.2 Describe the characteristics of various common metal stock.

E4.3.3 Identify samples of metal stock on laboratory equipment.

E4.3.4 List and discuss uses of common metal stock.

CRITERION-REFERENCED MEASURE

C4.3 Common metal stock identified with 90% accuracy on an instructor-prepared test.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Explain, demonstrate, and illustrate how to identify common metal stock (E4.3.1, E4.3.2).

2. Display samples and have students select stock by name. Have students collect their own samples and label them (E4.3.1-E4.3.3).

3. Have students blindfold each other and recognize various metal stocks through the sense of touch alone (E4.3.2).

4. Discuss industrial applications of common metal stock (E4.3.4).

SELECTED TOOLS AND MATERIALS

Handout: Instructor-prepared test
Metal stock samples: hexagonal and octagonal bar, round bar, square bar, structural shapes (angle, channel, tee I beam), tubing (round, square), sheets of galvanized steel, galvanized sheet iron, tin plate, black iron, copper, aluminum, stainless steel

SELECTED AUDIOVISUAL MATERIALS

None identified

SELECTED REFERENCES

Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

4. DESCRIBING CHARACTERISTICS OF METALS

TASK/COMPETENCY

4.4 Describe the specific characteristics of various metals

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology II (8442)

4.4

PERFORMANCE OBJECTIVE

P4.4 Given resource materials and samples of various metals, describe specific characteristics of various metals by listing with 100% accuracy three characteristics or uses of the following metals: carbon steels, alloy steels, aluminum, iron, chromium, copper, zinc, magnesium, nickel, titanium, gold, lead, pewter, silver, tin, and tungsten.

SELECTED ENABLING OBJECTIVES

E4.4.1 Locate information about each metal, using resource materials.

E4.4.2 Rank metals according to a particular characteristic such as hardness or machinability.

E4.4.3 Interpret the results of laboratory tests such as reaction to magnetism, chemicals, or stress test.

E4.4.4 Identify major sources of raw metals in the United States and in other countries.

CRITERION-REFERENCED MEASURE

C4.4 Three characteristics or uses listed for each metal with 100% accuracy.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students conduct library research to find specific information about various metals (E4.4.1, E4.4.2).

2. Perform laboratory tests to determine the reaction of specific metals to magnetism, chemicals, or stress upon the metal (E4.4.3).

3. Color code a map of the United States or the world to indicate major deposits of metals (E4.4.4).

SELECTED TOOLS AND MATERIALS

Samples of various metals
Magnet
Acid for etching (Note: Use extreme caution when handling acids.)

SELECTED AUDIOVISUAL MATERIALS

Films: Copper (02012). Audiovisual Services.
Tungsten (47608). Audiovisual Services.

SELECTED REFERENCES

Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

CONTENT/CONCEPT

5. PLANNING AND DESIGNING METAL PRODUCTS

TASKS/COMPETENCIES

5.1 Select a metal product for a project

5.2 Sketch proposed metal product

5.3 Fill out a bill of materials

5.4 Complete product plan sheet

5.5 Prepare working drawings

Application

CONTENT/CONCEPT

5. PLANNING AND DESIGNING METAL PRODUCTS

TASK/COMPETENCY

5.1 Select a metal product for a project

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

5.1

PERFORMANCE OBJECTIVE

P5.1 Given metal project ideas, a budget, and a time limit, select a metalworking project. Project selected must be appropriate according to time, cost, material and tool availability, and individual skill level.

SELECTED ENABLING OBJECTIVES

E5.1.1 Examine appropriateness of assorted metalworking projects. Estimate cost of project, identify tools and materials used, and estimate amount of time used to complete each project. Identify metalworking skills required to produce each project.

E5.1.2 Assess personal time, budget, interests, skill levels, and other factors to consider when selecting a metalworking project.

E5.1.3 Explain the following steps used in project planning: (a) sketches, (b) drawings, (c) bill of materials, (d) procedure, (e) required tools and materials, (f) cost estimates, (g) time estimate, and (h) other information.

E5.1.4 Analyze project for time and complexity to build.

CRITERION-REFERENCED MEASURE

C5.1 Metal product selected for a project. Project appropriate according to time, cost, material and tool availability, and individual skill level.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Display an assortment of completed metalworking projects reflecting a variety of skill levels. Discuss time, cost, materials, tool availability, student skills, and other factors to consider when selecting a project (E5.1.1, E5.1.2).

2. Outline and discuss steps for planning a project. Have students select a project. Assist in the decision-making process, if necessary, and approve all projects (E5.1.3).

3. Have class officers manage a seminar to hear each student discuss project selected and related information (E5.1.4).

SELECTED TOOLS AND MATERIALS

Assortment of completed projects
Sample bill of materials
Sample planning sheet

SELECTED AUDIOVISUAL MATERIALS

None identified

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

5. PLANNING AND DESIGNING METAL PRODUCTS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

5.2 Sketch proposed metal product

COURSE

Metals Technology I (8439
Metals Technology II (8442)

5.2

PERFORMANCE OBJECTIVE

P5.2 Given pencil and sketch pad, sketch the designs for a selected project. The sketches must receive an acceptable rating on an instructor-prepared checksheet.

SELECTED ENABLING OBJECTIVES

E5.2.1 Define type, shape, size, mass, color, tone, texture, proportion, balance, harmony, rhythm, and symmetry.

E5.2.2 Identify various sources for project designs.

E5.2.3 Define the following words: sketch, scale, and mock-up.

E5.2.4 Identify the function of a mock-up.

E5.2.5 Practice sketching designs for metalworking projects.

CRITERION-REFERENCED MEASURE

C5.2 Design for selected project sketched. All items on instructor-prepared checksheet rated acceptable.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Define, discuss, or illustrate key terms and concepts related to the elements and principles of design (E5.2.1).

2. Have students make a list of sources for product/project designs (E5.2.2).

3. Have students practice sketching a project, using the principles of design (E5.2.3, E5.2.5).

4. Have students identify a scale and build mock-up of project design (E5.2.3, E5.2.4).

SELECTED TOOLS AND MATERIALS

Handout: Instructor-prepared checksheet
Ruler
Scale
Sketch pad and pencil

SELECTED AUDIOVISUAL MATERIALS

Film: Drafting Drawing and Planning (42709). Audiovisual Services.

SELECTED REFERENCES

Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

5. PLANNING AND DESIGNING METAL PRODUCTS

TASK/COMPETENCY

5.3 Fill out a bill of materials

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

5.3

PERFORMANCE OBJECTIVE

P5.3 Given working drawings for a project, a bill of materials, and information concerning materials cost, fill out the bill of materials for the project. All calculations must be accurate, and all entries complete compared to a model bill of materials.

SELECTED ENABLING OBJECTIVES

E5.3.1 Define finish size, rough size, unit cost, and total cost.

E5.3.2 Identify and use guidelines for determining rough sizes for stock.

E5.3.3 Examine samples of completed bills of materials. Determine the types of information required.

E5.3.4 Demonstrate how to use a working drawing as a guide in filling out a bill of materials.

E5.3.5 Identify price of materials and supplies needed and calculate unit and total costs.

E5.3.6 Fill out bills of materials for selected metalworking projects.

CRITERION-REFERENCED MEASURE

C5.3 Bill of materials filled out correctly. All calculations accurate, and all entries complete as verified by a comparison with a model bill of materials.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Discuss key terms and concepts associated with the preparation and use of bill of materials (E5.3.1).
2. Demonstrate how to determine rough sizes for stock (E5.3.2).
3. Display sample bills of materials and discuss types of information included in the forms (E5.3.3).
4. Demonstrate how to fill out a bill of materials, using a working drawing as a guide (E5.3.4).
5. Discuss ways to determine price of materials and supplies. Demonstrate how to calculate unit and total costs (E5.3.5).
6. Supervise student practice in filling out bills of materials and assist with mathematical calculations (E5.3.6).

SELECTED TOOLS AND MATERIALS

Cost information for school items and store items
Handout: Bill of materials (blank forms)
Model bill of materials
Working drawings

SELECTED AUDIOVISUAL MATERIALS

None identified

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

5. PLANNING AND DESIGNING METALS PRODUCTS

TASK/COMPETENCY

5.4 Complete product plan sheet

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

5.4

PERFORMANCE OBJECTIVE

P5.4 Given resource materials, a planning sheet, and a selected project, complete the project planning sheet in accordance with teacher's instructions. The plan sheet must include working drawings, a bill of materials, tools needed, time schedule, and a step-by-step procedure on how to complete the project. All recorded information must be complete and accurate.

SELECTED ENABLING OBJECTIVES

E5.4.1 Identify and explain the purpose of each part of the planning sheet.

E5.4.2 Make working drawings and a bill of materials for a selected project.

E5.4.3 Identify tools and equipment needed for selected metalworking project.

E5.4.4 Fill out project planning sheets for selected project.

CRITERION-REFERENCED MEASURE

C5.4 Project planning sheet completed, to include working drawings, bill of materials, tools needed, time schedule, and a step-by-step procedure on how to complete the project. Information recorded completely and accurately.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Display sample project planning sheets. Identify and explain the purpose of each part of the form (E5.4.1).

2. Have students make working drawings and fill out a bill of materials for selected metalworking projects (E5.4.2).

3. Help students identify tools and equipment needed for individual projects (E5.4.3).

4. Demonstrate how to fill out project planning sheet (E5.4.4).

SELECTED TOOLS AND MATERIALS

Drawing equipment
Handout: Bills of materials form
Handout: Planning sheets or form

SELECTED AUDIOVISUAL MATERIALS

None identified

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

5. PLANNING AND DESIGNING METAL PRODUCTS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

5.5 Prepare working drawings

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

5.5

PERFORMANCE OBJECTIVE

P5.5 Given a specific metalworking project, resources, and drawing equipment, prepare working drawings by sketching the final project design, and making multiview and pictorial working drawings for the project. Working drawings must include dimensions; all lines must be clean and clear, and all drawings must be accurate.

SELECTED ENABLING OBJECTIVES

E5.5.1 Define working drawings, multiview drawings, pictorial drawings, scales, object lines, hidden lines, center lines, extension lines, dimension lines, and grid.

E5.5.2 Examine samples of working drawings and describe their characteristics and uses.

E5.5.3 Demonstrate how to draw to scale. Include increasing and decreasing dimensions.

E5.5.4 Use pictorial drawings for selected project; use a grid for irregular designs and curves.

E5.5.5 Make multiview drawings for selected projects. Select object, hidden, center, extension, and dimension lines.

CRITERION-REFERENCED MEASURE

C5.5 Working drawings prepared, including a sketch of the final project design and multiview and pictorial working drawings. Working drawings are accurate and include dimensions with lines clean and clear.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Define and discuss key terms and concepts related to working drawings (E5.5.1).
2. Display samples of working drawings. Discuss uses of pictorial and multiview drawings and demonstrate how to interpret the drawings (E5.5.2).
3. Demonstrate and have students practice drawing techniques and drawing to scale (E5.5.3).
4. Supervise student practice in making pictorial drawings (E5.5.4).
5. Demonstrate how to draw object, hidden, center, extension, and dimension lines on multiview drawings. Supervise student practice in making multiview drawings (E5.5.5).

SELECTED TOOLS AND MATERIALS

Drawing equipment or Computer Aided Drafting Program (Apple)
Sample multiview drawings
Sample pictorial drawings

SELECTED AUDIOVISUAL MATERIALS

Film: Drafting - Drawing and Planning (42709). Audiovisual Services.

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

CONTENT/CONCEPT

6. MEASURING AND LAYING OUT WORK

TASKS/COMPETENCIES

6.1 Identify measuring and layout tools and terms

6.2 Determine size of metal stock

6.3 Measure and mark stock, using English and metric systems

Application

CONTENT/CONCEPT

6. MEASURING AND LAYING OUT WORK

TASK/COMPETENCY

6.1 Identify measuring and layout tools and terms

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

6.1

PERFORMANCE OBJECTIVE

P6.1 Given resources, a selection of measuring and layout tools (both English and metric), and a list of measuring terms, identify and/or define the tools and terms with 90% accuracy.

SELECTED ENABLING OBJECTIVES

E6.1.1 Explain how length, weight, volume, area, temperature, and speed are measured in metric units and English (customary) units.

E6.1.2 Read and interpret a metric-English conversion chart and demonstrate how to convert English units to and from metric measures.

E6.1.3 Define centi, English (customary) system, decimal system, gram, kilo, meter, metric system, and milli.

E6.1.4 Describe the uses of the following: calipers, combination set, depth gauge, dial indicator, dividers, Jo blocks, layout dyes, machinist's hammer, metric-English conversion chart, micrometers, protractors, punches, scribers, steel rules, surface gauge, surface plate, tape measure (flexible), trammel, try square, V-blocks, vernier caliper, and vernier height gauge.

CRITERION-REFERENCED MEASURE

C6.1 Layout tools and terms identified with 90% accuracy.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Explain and discuss the English (customary) and metric measurement systems (E6.1.1).

2. Display a metric-English conversion chart and demonstrate how to convert selected measurements (E6.1.2).

3. Define and discuss key terms and concepts associated with laying out and measuring work (E6.1.3).

4. Display layout and measurements tools. Discuss uses for each tool or piece of equipment (E6.1.4).

SELECTED TOOLS AND MATERIALS

Calipers
Combination set*
Depth gauge
Dial indicator
Dividers
Jo blocks
Layout dyes
Machinist's hammer
Metric-English conversion chart
Micrometers
Protractors
Punches
Scribers
Steel rules
Surface gauge
Surface plate
Tape measure (flexible)
Trammel
Try square
V-blocks
Vernier caliper
Vernier height gauge

*(Combination head, center head, bevel protractor, spirit level, steel rule, scriber)

SELECTED AUDIOVISUAL MATERIALS

Films: Metal Work - Hand Tools--Layout Tools for Metal Work (41809) Audiovisual Services.
Precision Measuring - Combination Square (55509). Audiovisual Services.
Precision Measuring - Depth Gauge and Inside Micrometer (36610). Audiovisual Services.
Precision Measuring - Micrometer (55409). Audiovisual Services.
Precision Measuring - Vernier Calipers (36010). Audiovisual Services.

Filmstrips: Measuring Tools Explained Series. Bergwall. Titles: (1) The Vernier Caliper (2) The Outside Micrometer (3) Inside Micrometers (4) Depth Gauge (5) Dial Indicators (6) Protractors and "JO" Blocks.

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

6. MEASURING AND LAYING OUT WORK

TASK/COMPETENCY

6.2 Determine size of metal stock

PROGRAM

INDUSTRIAL ARTS (21.0199)

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

6.2

PERFORMANCE OBJECTIVE

P6.2 Given various pieces of metal stock and semi-precision/precision measurement instruments, determine size of metal stock and record the measurements on an instructor-prepared worksheet. Measurements within ±1/64 inch.

SELECTED ENABLING OBJECTIVES

E6.2.1 Explain dimensions used to describe size of metal stock.

E6.2.2 List tools commonly used to measure metal stock.

E6.2.3 State common sizes in which metal stock is manufactured.

E6.2.4 Demonstrate how to take measurements of metal stock, using micrometers, calipers, gauges, and rules.

CRITERION-REFERENCED MEASURE

C6.2 Size of metal stock determined and recorded on instructor-prepared worksheet; measurements within ±1/64 inch.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Prepare a handout listing the most common sizes of metal stock (E6.2.1, E6.2.3).

2. Display tools commonly used to measure metal stock (E6.2.2).

3. Demonstrate and have students take measurements of metal stock and record sizes (E6.2.4).

SELECTED TOOLS AND MATERIALS

Calipers
Gauges
Handout: Common sizes of metal stock
Handout: Instructor-prepared worksheet
Micrometers
Steel rule

SELECTED AUDIOVISUAL MATERIALS

Film: Metal Work - Hand Tools--Layout Tools for Metal Work (41809). Audiovisual Services.

Filmstrips: Measuring Tools Explained Series. Bergwall. Titles: (1) The Vernier Caliper (2) The Outside Micrometer (3) Inside Micrometers (4) Depth Gauges

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practices, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

6. MEASURING AND LAYING OUT WORK

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

6.3 Measure and mark stock, using English and metric systems

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

6.3

PERFORMANCE OBJECTIVE

P6.3 Given measuring and layout instructions, drawings, resource materials, English and metric measuring or layout tools, and different sizes of metal stock, measure and mark the stock, using both English and metric systems as directed by the instructor. All markings and recorded measurements must be in accordance with drawings.

SELECTED ENABLING OBJECTIVES

E6.3.1 Identify measuring and layout tools. List uses for each tool.

E6.3.2 Demonstrate how to take measurements, using the English and metric systems.

E6.3.3 Outline factors to consider when laying out work.

E6.3.4 Use chalk or layout dyes to prepare surface for marking.

E6.3.5 Measure and lay out work (straight lines, arcs, circles).

CRITERION-REFERENCED MEASURE

C6.3 Metal stock measured and marked using English and metric systems; markings and measurements in accordance with drawings.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Display measuring and layout tools and explain the purpose and use of each tool (E6.3.1).
2. Demonstrate and have students take measurements, using English and metric tools (E6.3.2).
3. Discuss factors to consider in laying out work. Demonstrate special layout techniques (E6.3.3).
4. Demonstrate use of chalk or layout dyes prior to scribing (E6.3.4).
5. Supervise student practice in using measuring and layout tools (E6.3.5).

SELECTED TOOLS AND MATERIALS

Calipers
Combination set*
Depth gauge
Dial indicator
Dividers
Jo blocks
Layout dyes
Machinist's hammer
Metric-English conversion chart
Micrometers
Protractors
Punches
Scribers
Steel rules
Surface gauge
Surface plate
Tape measure (flexible)
Trammel
Try square
V-blocks
Vernier caliper
Vernier height gauge
Measuring and layout instructions

*(Combination head, center head, bevel protracter, spirit level, steel rule, scriber)

SELECTED AUDIOVISUAL MATERIALS

Filmstrips: Measuring Tools Explained Series. Bergwall. Titles:
(1) The Vernier Caliper (2) The Outside Micrometer
(3) Inside Micrometers (4) Depth Gauges

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.
Using Metrics in Industrial Arts. E. Allen Bame.

CONTENT/CONCEPT

7. USING METALWORKING HAND TOOLS

TASKS/COMPETENCIES

7.1 Use hand hacksaw

7.2 Use cold chisels

7.3 Use files

7.4 Select bit and drill metal, using a hand-held drill

Application

CONTENT/CONCEPT

7. USING METALWORKING HAND TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

7.1 Use hand hacksaw

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

7.1

PERFORMANCE OBJECTIVE

P7.1 Given a hand hacksaw, an assortment of blades, and different metal samples, use the hand hacksaw to make cuts assigned by the instructor. All items on an instructor-prepared checksheet must receive an acceptable rating. All safety precautions must be observed.

SELECTED ENABLING OBJECTIVES

E7.1.1 Identify parts of the hand hacksaw.

E7.1.2 Identify different hacksaw blades by size, by type of material from which made, and by type of material the blade is designed to cut.

E7.1.3 Determine the number of teeth per inch or blade pitch.

E7.1.4 Position blade in handle with teeth pointing away from the handle.

E7.1.5 Secure work in vise after marking cut to be made. Use blocks to secure thin metal.

E7.1.6 Cut material using pressure on the forward stroke at the rate of 40 cutting strokes per minute.

E7.1.7 Identify all safety procedures.

CRITERION-REFERENCED MEASURE

C7.1 Hand hacksaw used to make cuts. All items on instructor-prepared checksheet rated acceptable, and all safety precautions observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students label the parts of a hand hacksaw on a handout or poster (E7.1.1).

2. Provide an assortment of hacksaw blades and let students discover which metal samples are best cut with a particular blade (E7.1.2, E7.1.3).

3. Assign students different metal samples to be cut and evaluate the student's performance on a checksheet (E7.1.4-E7.1.6).

4. Review and emphasize all safety procedures (E7.1.7).

SELECTED TOOLS AND MATERIALS

Combination square
Hacksaw blades
Hand hacksaw
Handout: Instructor-prepared checksheet
Scriber
Vise
Wooden blocks
Samples of metals

SELECTED AUDIOVISUAL MATERIALS

Film: Hand Tools for Metal Work (48912). Audiovisual Services.
Filmstrip: Bench Metalwork Series. Bergwall. Title: (2) Cutting Processes.

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp. and others.

Application

CONTENT/CONCEPT

7. USING METALWORKING HAND TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

7.2 Use cold chisels

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

7.2

PERFORMANCE OBJECTIVE

P7.2 Given cold chisels, hammers, goggles, marking tools, and different metal samples, use cold chisels to make cuts assigned by the instructor. All items on an instructor-prepared checksheet must receive an acceptable rating, and all safety procedures must be observed.

SELECTED ENABLING OBJECTIVES

E7.2.1 Identify the different kinds of cold chisels by their cutting edge.

E7.2.2 Determine the angle of the cutting edge, using a center gauge.

E7.2.3 Sharpen the cutting edge and taper and round the head on a grinder.

E7.2.4 Cut material in a safe manner (flat stock, rods, rivets).

CRITERION-REFERENCED MEASURE

C7.2 Cold chisels used to make cuts. All items on instructor-prepared checksheet rated acceptable, and all safety procedures observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students label the types and parts of various cold chisels on a handout or poster (E7.2.1).

2. Provide an assortment of cold chisels and let students discover which metal samples are best cut with a particular cold chisel (E7.2.1, E7.2.2).

3. Assign students different metal samples to be cut and evaluate the students' performance on a checksheet (E7.2.1-E7.2.4).

SELECTED TOOLS AND MATERIALS

Cold chisels
Goggles
Hammers
Handout: Instructor-prepared checksheet
Samples of metal
Scriber

SELECTED AUDIOVISUAL MATERIALS

Film: Hand Tools for Metal Work (48912). Audiovisual Services.

SELECTED REFERENCES

Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

7. USING METALWORKING HAND TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

7.3 Use files

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

7.3

PERFORMANCE OBJECTIVE

P7.3 Given an assortment of files, file handles, file card, measuring instruments, workpiece, and drawings, use files to shape workpiece to specifications on drawing.

SELECTED ENABLING OBJECTIVES

E7.3.1 Identify parts and shapes of commonly used files.

E7.3.2 Describe the uses of a particular type of file.

E7.3.3 Check the file handle for secure fit.

E7.3.4 Clean the file, if needed.

E7.3.5 Mount the workpiece.

E7.3.6 File material in a safe manner to the final tolerance.

CRITERION-REFERENCED MEASURE

C7.3 Files used to shape workpiece. Finished workpiece meets specifications on drawing.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Demonstrate the proper use of handles and methods of holding files (E7.3.1-E7.3.3).

2. Demonstrate the proper work-holding methods and techniques (E7.3.5).

3. Have students identify the various file sizes, shapes, and uses (E7.3.1).

4. Demonstrate the use of measuring instruments for flatness, squareness, and angles (E7.3.6).

5. Demonstrate the proper use of a file card (E7.3.4).

SELECTED TOOLS AND MATERIALS

Drawings
File card
File handles
Files (assorted)
Measuring instruments
Workpiece

SELECTED AUDIOVISUAL MATERIALS

Film: Hand Tools for Metal Work (48912). Audiovisual Services.
Filmstrip: Bench Metalwork Series. Bergwall. Title: (3) Files and the Filing Process.

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

7. USING METALWORKING HAND TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

7.4 Select bit and drill metal, using a hand-held drill

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

7.4

PERFORMANCE OBJECTIVE

P7.4 Given instructions and resource materials, an electric drill, safety goggles, selected boring tools, and scrap stock, select the correct bit and drill metal, using a hand-held drill. All operations, including handling, and chuck and drill mounting, must conform to safety standards and must be in accordance with instructor's guidelines.

SELECTED ENABLING OBJECTIVES

E7.4.1 List and explain rules for safe operation of an electric drill.

E7.4.2 Identify drill sizes (1/4, 3/8, 1/2 inch), and examine and identify twist drills, masonry drills, speed bores, spade bits, wire brushes, or other boring tools used with an electric drill. State uses for each drill size and boring tool.

E7.4.3 Explain and/or demonstrate the following: (a) application of safety rules; (b) how to use double-insulated portable tools and a ground plug an/or adaptor for proper grounding; (c) how to select drill size and the proper boring tool; (d) use of drill stops or depth gauges; (e) methods used to drill straight, such as try square, square, dowelling, or jig.

E7.4.4 Select the proper boring tool for designated projects.

E7.4.5 Demonstrate the safe and correct operation of a portable electric drill for drilling holes for metal screws.

CRITERION-REFERENCED MEASURE

C7.4 Bits selected and metal drilled using a hand-held drill. All operations conform to safety standards and are in accordance with instructor's guidelines.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students view safety films on use of the portable drill. Give safety test after classroom demonstration (E7.4.1).

2. Display different sizes of drills and selected boring tools. Have students identify each drill or tool and discuss uses (E7.4.2).

3. Demonstrate the safe and proper use of an electric drill. Discuss the following topics: (a) safety, (b) grounding, (c) drill size and boring tool selection, (d) drill stops and depth gauges, and (e) drilling methods (E7.4.3).

4. Have students practice selecting the proper boring tools or drill sizes for designated jobs (E7.4.4).

5. Supervise student practice in operation of an electric drill (E7.4.5).

SELECTED TOOLS AND MATERIALS

Grounding adapter, if necessary
Metal
Metalworking vise
Portable electric drill
Safety goggles
Selected boring tools
Handout: Instructor guidelines

SELECTED AUDIOVISUAL MATERIALS

Filmstrip: Bench Metalwork Series. Bergwall. Title: Drilling, Reaming, and Threading.

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

CONTENT/CONCEPT

8. USING SHEET METAL TOOLS

TASKS/COMPETENCIES

8.1 Cut sheet metal with hand tools

8.2 Shape sheet metal with hand tools

8.3 Use sheet metal forming machines

8.4 Use sheet metal bending machines

8.5 Use sheet metal cutting machines

Application

CONTENT/CONCEPT

8. USING SHEET METAL TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

8.1 Cut sheet metal with hand tools

COURSE

Metals Technology I (8439)

8.1

PERFORMANCE OBJECTIVE

P8.1 Given a pattern and metal, cut sheet metal with various hand tools. The completed cuts must match the pattern used. All safety precautions must be observed.

SELECTED ENABLING OBJECTIVES

E8.1.1 Identify hand tools used to cut sheet metal, such as tin snips, aviation snips, double-cutting shears, hacksaw, chisel, and punches.

E8.1.2 Select the proper tool for the cut being made.

E8.1.3 Observe safety precautions when handling tools and sharp metal edges.

E8.1.4 Describe how to make straight, left cutting, right cutting, and circular cuts.

CRITERION-REFERENCED MEASURE

C8.1 Sheet metal cut with hand tools. Completed cuts match pattern used. All safety precautions observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Prepare flash card pictures or displays of various sheet metal cutting hand tools for tool identification (E8.1.1).

2. Prepare patterns for several different cuts that may be made with hand tools and have students determine tool to be used (E8.1.2).

3. Present demonstration of cutting sheet metal that also emphasizes safety practices to be observed (E8.1.3).

4. Have students perform various cutting operations to match a particular pattern (E8.1.4).

SELECTED TOOLS AND MATERIALS

Ballpeen hammer
Cold chisel
Combination square
Double-cutting shear
Hollow punch
Hand snips
(straight, curved, circular, hawk-billed, aviation)
Notcher (hand operated)
Pattern
Scratch awl
Solid punch
Turret punch

SELECTED AUDIOVISUAL MATERIALS

Filmstrips: Sheet Metalwork Series. Bergwall. Titles: (1) Introduction and Overviews (2) Straight Line Pattern Development (3) Parallel and Radial Line Pattern Development (5) Drilling, Forming and Bending-Part One (6) Forming and Bending-Part Two.

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

8. USING SHEET METAL TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

8.2 Shape sheet metal with hand tools

COURSE

Metals Technology I (8439)

8.2

PERFORMANCE OBJECTIVE

P8.2 Given a pattern and metal, shape sheet metal with hand tools. The completed shape must match the pattern used. All safety precautions must be observed.

SELECTED ENABLING OBJECTIVES

E8.2.1 Identify hand tools used to shape sheet metal, such as flat-nosed pliers, hand seamer, hand groover, raising hammer, setting hammer, various stakes, and mallet.

E8.2.2 Select proper tool for the shape to be made.

E8.2.3 Observe safety precautions when handling tools and sharp metal edges.

E8.2.4 Describe how to make angular bends, cylindrical shapes, and cone-shaped articles to a prescribed pattern.

CRITERION-REFERENCED MEASURE

C8.2 Sheet metal shaped with hand tools. Completed shape matches pattern, and all safety precautions observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Prepare flash card pictures or displays of various sheet metal shaping hand tools for identification purposes (E8.2.1).

2. Prepare patterns for several different shapes that may be made with hand tools and have students determine tool to be used (E8.2.2).

3. Present demonstration of shaping sheet metal that also emphasizes safety practices to be observed (E8.2.3).

4. Have students perform various bending operations to match a particular pattern (E8.2.4).

SELECTED AUDIOVISUAL MATERIALS

Ballpeen hammer
C-clamps
Cold chisel
Combination square
Double-cutting shear
Double-cutting shear bench plate
Sheet Metal
Hand punch
Hardwood blocks
Hollow punch
Hand Snips
(straight, curved, circular, hawk-billed, aviation)
Metal
Notcher (hand operated)
Pattern
Scratch awl
Solid punch
Steel bars
Turret punch
Various stakes*
Vise

* breakhorn, bottom, coppersmith, common square, leveled-edge, double-seaming, round-heat, hatchet, creasing, needle case, candlemold, blowhorn, conductor, hollow mandrel

SELECTED TOOLS AND MATERIALS

Filmstrips: Sheet Metalwork Series. Bergwall. Titles: (1) Introduction and Overviews (2) Straight Line Pattern Development (3) Parallel and Radial Line Pattern Development (5) Drilling, Forming and Bending-Part One (6) Forming and Bending-Part Two.

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

8. USING SHEET METAL TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

8.3 Use sheet metal forming machines

COURSE

Metals Technology I (8439)

8.3

PERFORMANCE OBJECTIVE

P8.3 Given a pattern and metal, form sheet metal with various forming machines. The completed sheet metal forms must match the pattern used, and all safety procedures must be observed.

SELECTED ENABLING OBJECTIVES

E8.3.1 Identify machines used to form sheet metal, such as the slip-roll forming machine, turning machine, wiring machine, burring machine, setting-down machine, double-seaming machine, crimping and bending machine, grooving machine, and Pittsburg lock forming machine.

E8.3.2 Select the proper machine for the form to be made.

E8.3.3 Observe safety precautions when using forming machines and handling sharp metal edges.

E8.3.4 Describe how to perform operations with various forming machines to match pattern supplied by the instructor.

CRITERION-REFERENCED MEASURE

C8.3 Sheet metal forming machines used to form sheet metal. Completed forms match patterns, and all safety procedures observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students identify machines and their components that are used to form sheet metal (E8.3.1).

2. Demonstrate forms that may be constructed with each machine (E8.3.2).

3. Present demonstration of forming sheet metal that also emphasizes safety precautions to be observed (E8.3.3).

4. Have students perform various forming operations to match a particular pattern (E8.3.4).

SELECTED TOOLS AND MATERIALS

Burring machine
Crimping and bending machine
Double-seaming machine
Grooving machine
Pittsburg lock forming machine
Setting-down machine
Slip-roll forming machine
Turning machine
Wiring machine

SELECTED AUDIOVISUAL MATERIALS

Filmstrips: Sheet Metalwork Series. Bergwall. Titles: (1) Introduction and Overviews (2) Straight Line Pattern Development (3) Parallel and Radial Line Pattern Development (5) Drilling, Forming and Bending-Part One (6) Forming and Bending-Part Two (7) Assembly and Fastening.
Sheet Metal Fabricating Machinery Explained Series. Bergwall. Title: (a) The Hand Operated Slip Roller.

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

8. USING SHEET METAL TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

8.4 Use sheet metal bending machines

COURSE

Metals Technology 1 (8439)

8.4

PERFORMANCE OBJECTIVE

P8.4 Given a pattern and metal, bend sheet metal with various bending machines. The completed bends must match the pattern used. All safety precautions must be observed.

SELECTED ENABLING OBJECTIVES

E8.4.1 Identify machines used to bend sheet metal such as the bar folder, cornice brake, press brake, and box and pan brake.

E8.4.2 Select the proper machine for the bend being made.

E8.4.3 Observe safety precautions when using machines and handling sharp objects.

E8.4.4 Explain how to make a sharp fold, a rounded fold, right-angle folds, a hem, a double hem, and a box using the machines above.

CRITERION-REFERENCED MEASURE

C8.4 Sheet metal bending machines used to bend sheet metal. Completed bends match patterns, and all safety precautions observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students identify machines and their components that are used to bend sheet metal (E8.4.1).

2. Demonstrate bends that may be constructed with each machine (E8.4.2).

3. Present demonstration of bending sheet metal that also emphasizes safety precautions to be observed (E8.4.3).

4. Have students perform various forming operations to match a particular pattern (E8.4.4).

SELECTED TOOLS AND MATERIALS

Bar folder
Box and pan brake
Cornice brake
Mallet
Metal
Press brake
Setting hammer

SELECTED AUDIOVISUAL MATERIALS

Filmstrips: Machine Operation-Sheet Metal (82909). Audiovisual Services.
Sheet Metalwork Series. Bergwall. Titles: (1) Introduction and Overviews (2) Straight Line Pattern Development (3) Parallel and Radial Line Pattern Development (5) Drilling, Forming and Bending-Part One (6) Forming and Bending-Part Two.
Sheet Metal Fabricating Machinery Explained. Bergwall. Titles: (6) The Hand Operated Press Brake (7) The Finger Brake (8) The Hand Operated Bender.

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

8. USING SHEET METAL TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

8.5 Use sheet metal cutting machines

COURSE

Metals Technology I (8439)

8.5

PERFORMANCE OBJECTIVE

P8.5 Given a pattern and metal, use sheet metal cutting machines. The completed cuts must match the pattern used. All safety precautions must be observed.

SELECTED ENABLING OBJECTIVES

E8.5.1 Identify machine tools used to cut sheet metal, such as squaring shears, notcher, ring and circle shear, lever shear, electrically powered nibblers, and portable electric shears.

E8.5.2 Select the proper machine for the cut being made.

E8.5.3 Observe safety precautions when using machines and handling sharp metal objects.

E8.5.4 Explain how to make square, circular, or angular cuts.

CRITERION-REFERENCED MEASURE

C8.5 Sheet metal cutting machine used to cut metal. Completed cuts match patterns, and all safety precautions observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students identify machines and their components that are used to cut sheet metal (E8.5.1).

2. Demonstrate cuts that may be made with each machine (E8.5.2).

3. Present demonstration of cutting sheet metal that also emphasizes safety precautions to be observed (E8.5.3).

4. Have students perform various cutting operations to match a particular pattern (E8.5.4).

SELECTED TOOLS AND MATERIALS

Combination square
Electrically powered nibblers
Level shear
Notcher (power operated)
Portable electric shears
Ring and circle shear
Scratch awl
Sheet metal
Squaring shear

SELECTED AUDIOVISUAL MATERIALS

Filmstrips: Sheet Metalwork Series. Bergwall. Titles: (1) Introduction and Overviews (2) Straight Line Pattern Development (3) Parallel and Radial Line Pattern Development (5) Drilling, Forming and Bending-Part One (6) Forming and Bending-Part Two.
Sheet Metal Fabricating Machinery Explained. Bergwall. Titles: (1) The Foot Operated Shear (2) The Turret Punch Press (3) The Tab Notcher (4) The Hand Operated Shear (5) The Single Station Punch.

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

CONTENT/CONCEPT

9. USING FASTENERS AND SOLDER

TASKS/COMPETENCIES

9.1 Identify threaded fasteners

9.2 Fasten metal, using rivets

9.3 Thread metal rod and drilled holes

9.4 Solder metal, using appropriate fluxes and solder

Application

CONTENT/CONCEPT

9. USING FASTENERS AND SOLDER

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

9.1 Identify threaded fasteners

COURSE

Metals Technology I (8439)

9.1

PERFORMANCE OBJECTIVE

P9.1 Given an assortment of threaded fasteners, name tags, and reference material, identify the threaded fasteners by placing each fastener with its respective name tag with a minimum of 95% accuracy.

SELECTED ENABLING OBJECTIVES

E9.1.1 Locate reference material concerned with identifying threaded fasteners.

E9.1.2 Distinguish fasteners by determining identifying characteristic(s) for each fastener.

E9.1.3 Explain differences between Unified National Coarse and Unified National Fine Threads.

E9.1.4 Identify machine bolts, stud bolts, and carriage bolts.

E9.1.5 Identify machine screws, cap screws, set screws, thumbscrews and wing-screws, thread forming screws, thread cutting screws, and drive screws.

E9.1.6 Identify common nuts used with bolts.

CRITERION-REFERENCED MEASURE

C9.1 Threaded fasteners identified with 95% accuracy.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students secure reference materials that may be used to identify threaded fasteners. Manufacturer's charts may be employed for this activity (E9.1.1).

2. Prepare a list of all the threaded fasteners that students are expected to identify. Have students write one or more identifying characteristic for each fastener (E9.1.1, E9.1.2).

3. Lay out various threaded fasteners on a work bench. Have students discover differences between the three types of threads (E9.1.3-E9.1.6).

SELECTED TOOLS AND MATERIALS

Cap screws
Carriage bolts
Drive screws
Machine bolts
Machine screws
Nuts
Set screws
Stud bolts
Thread cutting screws
Thread forming screws
Thumbscrews
Wingscrews

SELECTED AUDIOVISUAL MATERIALS

None identified

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

9. USING FASTENERS AND SOLDER

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

9.2 Fasten metal, using rivets

COURSE

Metals Technology I (8439)

9.2

PERFORMANCE OBJECTIVE

P9.2 Given an assortment of rivets, rivet sets, punches, ball peen hammer, pop rivet gun, and metal samples, fasten metal, using rivets. All items on an instructor-prepared checklist must be rated acceptable.

SELECTED ENABLING OBJECTIVES

E9.2.1 Identify various types of rivets (black-iron, galvanized, copper) and their uses.

E9.2.2 Describe use of rivet sets and pop rivet guns.

E9.2.3 Determine length and diameter of rivet to be used.

E9.2.4 Determine spacing of rivets for a particular situation.

E9.2.5 Explain how to remove rivets.

CRITERION-REFERENCED MEASURE

C9.2 Metal fastened with rivets, and all items on instructor-prepared checklist rated acceptable.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students prepare a wall board display of rivets by identifying each rivet and its intended use (E9.2.1).

2. Demonstrate using riveting tools and rivets on sheet metal and wrought iron samples (E9.2.2).

3. Have students determine correct rivet(s) to be used for a particular situation (E9.2.1, E9.2.3).

4. Have students install and/or remove rivets and evaluate their work (E9.2.1-E9.2.5).

SELECTED TOOLS AND MATERIALS

Handout: Instructor-prepared checklist
Metal samples
Pop rivet gun
Punches
Rivet set
Riveting hammer
Ball peen hammer

SELECTED AUDIOVISUAL MATERIALS

Filmstrips: Bench Metalwork Series. Bergwall. Title: (6) Peening, Finishing and Assembly.
Sheet Metalwork Series. Bergwall. Title: (7) Assembly and Fastening.

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

9. USING FASTENERS AND SOLDER

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

9.3 Thread metal rod and drilled holes

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

9.3

PERFORMANCE OBJECTIVE

P9.3 Given a tap set, a hand die set, metal stock, lubricant, holding device, and a blueprint, thread metal rod and drilled holes to form external and internal threads that meet the specifications outlined on the blueprint.

SELECTED ENABLING OBJECTIVES

E9.3.1 Identify components of a tap set. Include taper plugs, and bottoming taps.

E9.3.2 Identify components of a die set. Include solid and adjustable dies.

E9.3.3 Determine the specifications from the blueprint for both external and internal threads.

E9.3.4 Define terms associated with screw threader: major diameter, minor diameter, pitch, lead, lead angle, multiple thread, crest, root, side or flank, clearance, height of thread, screw pitch gauge, unified screen threads, thread classes, pipe threads, and ISO metric threads.

E9.3.5 Outline a procedure for cutting an external thread with a die and diestock.

E9.3.6 Outline a procedure for cutting an internal thread with a tap and tap wrench.

E9.3.7 Compare finished product with blueprint specifications.

CRITERION-REFERENCED MEASURE

C9.3 Metal rod and drilled roles threaded. External and internal threads meet specifications outlined on blueprint.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students examine a tap set and die set to discover the components and uses of each set (E9.3.1, E9.3.2).

2. Demonstrate how to read blueprint specifications for tap and die applications (E9.3.3).

3. Have students examine screw threads in relationship to terms to be defined, and have students illustrate each term (E9.3.4).

4. Demonstrate usage of taps and dies, using a procedure specified to students that will produce work meeting the blueprint specifications (E9.3.5-E9.3.7).

SELECTED TOOLS AND MATERIALS

Blueprint
Die set
File
Holding device
Lubricant (cutting oil)
Metal stock
Rule
Tap set

SELECTED AUDIOVISUAL MATERIALS

Filmstrip: Bench Metalwork Series. Bergwall. Title: (5) Drilling, Reaming, and Threading.

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

9. USING FASTENERS AND SOLDER

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

9.4 Solder metal, using appropriate fluxes and solder

COURSE

Metals Technology I (8439)

9.4

PERFORMANCE OBJECTIVE

P9.4 Given metal, cleaning materials, flux, solder, and a heat source, solder metal, using appropriate fluxes and solder. All examples should meet criteria specified in instructor's guidelines, and all safety procedures must be observed.

SELECTED ENABLING OBJECTIVES

E9.4.1 Identify materials used for soldering.

E9.4.2 List situations where soldering is the appropriate fastening technique.

E9.4.3 Distinguish between hard and soft soldering and the applications of each type.

E9.4.4 Form joints in sheet metal to be soldered.

E9.4.5 Clean metal surfaces and prepare soldering coppers.

E9.4.6 Select correct flux, soder, and application tool for a given situation.

E9.4.7 Describe safety regulations to be observed while soldering.

CRITERION-REFERENCED MEASURE

C9.4 Appropriate fluxes and solder used to solder metal in accordance with instructor's guidelines. All safety procedures observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students examine and identify materials used for soldering (E9.4.1)

2. Have students keep a log for three days, and have them observe and record all the applications where solder has been used (E9.4.2).

3. Explain the concept of hard and soft soldering (E9.4.3).

4. Have students prepare metal surfaces and form joints for soldering (E9.4.4, E9.4.5).

5. Have students solder several samples requiring the use of different fluxes, solders, and application tools (E9.4.1-E9.4.7).

SELECTED TOOLS AND MATERIALS

Abrasive cloth
Cleaning fluid
Electric soldering iron
File
Fluxes
Sal ammoniac
Soldering coppers
Soldering torch (bottled gas)
Solders
Steel wool
Wire brush

Handout: Instructor-prepared guidelines

SELECTED AUDIOVISUAL MATERIALS

Films: Soft Soldering (62304). Audiovisual Services.
Soldering and Brazing Copper Tubing (71210). Audiovisual Services.

Filmstrip: Sheet Metalwork Series. Bergwall. Title: (7) Assembly and Fastening.

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

CONTENT/CONCEPT

10. FORMING METAL

TASKS/COMPETENCIES

10.1 Cast metal with sand casting techniques

10.2 Heat treat metals

10.3 Bend rod and bar stock

10.4 Forge metal

Application

CONTENT/CONCEPT

10. FORMING METAL

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

10.1 Cast metal with sand casting techniques

COURSE

Metals Technology I (8439)

10.1

PERFORMANCE OBJECTIVE

P10.1 Given foundry equipment and accessories, safety equipment, and procedure sheets, cast metal with sand casting techniques. All items on instructor-prepared checksheet must be rated acceptable, and all safety precautions must be observed.

SELECTED ENABLING OBJECTIVES

E10.1.1 Identify equipment and supplies used for sand casting.

E10.1.2 List safety precautions and safety equipment used while casting metals.

E10.1.3 Determine the proper moisture content and hardness for green sand molds.

E10.1.4 Describe the preparation of patterns used for sand casting.

E10.1.5 Explain how to prepare a gating system for a sand mold.

E10.1.6 Heat metal and pour into mold.

E10.1.7 Remove mold and clean casting.

CRITERION-REFERENCED MEASURE

C10.1 Metal cast with sand casting techniques. All items on instructor-prepared checksheet rated acceptable, and all safety precautions observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Prepare a procedure sheet or sheets that describe an exercise requiring a one-piece pattern made with a green-sand mold. Be sure to include safety precautions to be observed (E10.1.1-E10.1.7).

2. Describe and demonstrate the process of sand casting (E10.1.1-E10.1.7).

3. Have students prepare molds for sand casting (E10.1.4).

4. Show appropriate filmstrips from the Foundry Work Series and discuss (E10.1.1-E10.1.7).

SELECTED TOOLS AND MATERIALS

Foundry equipment and accessories
Handouts: Instructor-prepared checksheet
How to Cast a One-Piece Pattern
Safety equipment

SELECTED AUDIOVISUAL MATERIALS

Film: Cast Iron-The Biography of a Metal (25312). Audiovisual Services.
Filmstrip: Foundry Work Series. Bergwall. Titles: (1) Introduction and Overview (2) Tools and Equipment (3) Preparing and Pouring a One Piece Casting-Part One (4) Preparing and Pouring a One-Piece Casting-Part Two (5) Preparing a Split Pattern Casting (6) Foundry (Match Plate Pattern).

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

10. FORMING METAL

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

10.2 Heat treat metals

COURSE

Metals Technology I (8439)

10.2

PERFORMANCE OBJECTIVE

P10.2 Given an electric or gas-fired heat-treatment furnace, different metals, handling tools, safety equipment, and instructor's guidelines and specifications, heat treat metals following the instructions given by the instructor. Metal must pass a test to determine if heat treating produced specified result. All safety precautions must be observed.

SELECTED ENABLING OBJECTIVES

E10.2.1 List the three basic steps used for heat treatment of metals.

E10.2.2 Identify the principal kinds of heat treatment processes (hardening, tempering, annealing, normalizing, case-hardening, flame hardening, and induction hardening).

E10.2.3 List the procedures for completing each hardening and tempering type of heat treatment.

E10.2.4 Describe steel according to carbon content and the uses for each type.

CRITERION-REFERENCED MEASURE

C10.2 Metals heat treated in accordance with instructor's directions and guidelines. A test of the metal indicates heat treating produced specified result. All safety precautions observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students review the three basic steps used for the heat treatment of metals in relationship to the various heat treatment processes. Have students prepare a chart that illustrates these relationships (E10.2.1-E10.2.3).

2. Demonstrate various heat-treatment processes for various steels and have students perform assigned tasks. Have students use various carbon steels and compare results using each assigned process (E10.2.1-E10.2.4).

SELECTED TOOLS AND MATERIALS

Electric or gas-fired heat-treatment furnace
Handling tools
Metal
Safety equipment
Handout: Instructor guidelines and specifications

SELECTED AUDIOVISUAL MATERIALS

None identified

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

10. FORMING METAL

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

10.3 Bend rod and bar stock

COURSE

Metals Technology I (8439)

10.3

PERFORMANCE OBJECTIVE

P10.3 Given rod and bar stock, vise, hammer, monkey wrench, lengths of pipe, bending fork, bending jig, universal bending machine, and measuring tools, bend rod and bar stock to specified length and shape. Completed piece must meet accuracy tolerances established by the instructor.

SELECTED ENABLING OBJECTIVES

E10.3.1 Identify tools used to bend rod and bar stock.

E10.3.2 Describe how to bend and shape rod and bar stock.

E10.3.3 Explain how to calculate bend allowances for various thicknesses of metal.

E10.3.4 Describe how to bend curves using a bending fork or bending jig.

E10.3.5 Explain the procedure for using a universal bending machine.

CRITERION-REFERENCED MEASURE

C10.3 Rod and bar stock bent to specified length and shape and meets accuracy tolerances established by instructor.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students name tools used to bend rod and bar stock (E10.3.1).

2. Demonstrate how to bend and shape bar stock and rods. Explain the concept and formulas for bending allowance (E10.3.2-E10.3.4).

3. Have students perform tasks assigned by the instructor requiring bending of rod and bar stock (E10.3.1-E10.3.5).

4. Demonstrate and have students use a universe bending machine to form a simple product (E10.3.5).

SELECTED TOOLS AND MATERIALS

Bending fork
Hammers
Lengths of pipe
Measuring tools
Monkey wrench
Rod and bar stock
Universal bending jig
Universal bending machine

SELECTED AUDIOVISUAL MATERIALS

Filmstrip: Bench Metalwork Series. Bergwall. Title: (4) Bending and Shaping.

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

10. FORMING METAL

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

10.4 Forge metal

COURSE

Metals Technology I (8439)

10.4

PERFORMANCE OBJECTIVE

P10.4 Given a gas furnace or gas forge, anvil, hand forging tools, and safety equipment, forge metal using hand forging techniques. Three exercises assigned by the instructor must receive an acceptable rating on an instructor-prepared checksheet. All safety procedures must be observed.

SELECTED ENABLING OBJECTIVES

E10.4.1 Explain how to light a gas furnace or gas forge.

E10.4.2 Identify tools and their uses for hand forging metal.

E10.4.3 Identify forging temperatures by color of heated steel.

E10.4.4 Determine types of work that can be done on the forge.

CRITERION-REFERENCED MEASURE

C10.4 Metals forged using hand forging techniques, and work is rated acceptable on instructor-prepared checksheet. All safety procedures observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Demonstrate how to light a gas furnace or gas forge. Emphasize safety precautions to be followed (E10.4.1).

2. Have students name and describe uses for various hand forging tools (E10.4.2).

3. Prepare three exercises for students that require hand forging. Demonstrate how to complete these exercises (E10.4.2-E10.4.4).

SELECTED TOOLS AND MATERIALS

Anvil
Blacksmith chisels
Blacksmith punches
Fullers
Gas furnace or forge
Hammers
Handout: Instructor-prepared checksheet
Swages

SELECTED AUDIOVISUAL MATERIALS

Film: Forge and Ornamental Iron (82609). Audiovisual Services.

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

CONTENT/CONCEPT

11 WELDING METAL

TASKS/COMPETENCIES

11.1 Spot weld sheet metal

11.2 Use an oxyacetylene welder

11.3 Use an electric arc welder

Application

CONTENT/CONCEPT

11. WELDING METAL

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

11.1 Spot weld sheet metal

COURSE

Metals Technology I (8439)

11.1

PERFORMANCE OBJECTIVE

P11.1 Given safety goggles, sheet metal, file, and a spot welder, spot weld sheet metal. An exercise assigned by the instructor must receive an acceptable rating on an instructor-prepared checksheet. All safety procedures must be observed.

SELECTED ENABLING OBJECTIVES

E11.1.1 Identify parts and the theory of operation of spot welders.

E11.1.2 List safety precautions and equipment needed for spot welding.

E11.1.3 Inspect spot welder tongs and dress with a file, if needed.

E11.1.4 Determine thickness of metal that can be spot welded successfully.

E11.1.5 Describe a procedure for determining length of welding time and cooling time.

E11.1.6 Test weld to determine strength of spot weld.

CRITERION-REFERENCED MEASURE

C11.1 Sheet metal spot welded, and all safety procedures observed. An acceptable rating on an instructor-prepared checksheet achieved.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students identify spot welding equipment components by orally naming each part (E11.1.1).

2. Review safety precautions to be followed while using a spot welder (E11.1.2).

3. Demonstrate the correct procedure for inspecting and operating the spot welder (E11.1.3-E11.1.6).

4. Have students complete the exercise assigned and evaluate using an instructor-prepared checksheet (E11.1.1-E11.1.6).

SELECTED TOOLS AND MATERIALS

File
Handout: Instructor-prepared checksheet
Safety goggles
Sheet metal
Spot welder

SELECTED AUDIOVISUAL MATERIALS

Film: Welding--Fusion Welding of Light Gauge Steel (13006). Audio-visual Services.

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT	PROGRAM
11. WELDING METALS	INDUSTRIAL ARTS (21.0199)
TASK/COMPETENCY	**COURSE**
11.2 Use an oxyacetylene welder	Metals Technology I (8439) Metals Technology II (8442)

11.2

PERFORMANCE OBJECTIVE

P11.2 Given oxyacetylene welding equipment, supplies, and metal, use an oxyacetylene welder to complete three exercises assigned by the instructor. Each exercise must receive an acceptable rating on an instructor-prepared checksheet, and all safety precautions must be observed.

SELECTED ENABLING OBJECTIVES

E11.2.1 Identify oxyacetylene welding equipment and supplies.

E11.2.2 Describe safety precautions and safety equipment used while oxyacetylene welding.

E11.2.3 List a start-up procedure for oxyacetylene welding.

E11.2.4 Explain how to light the torch and adjust the flame.

E11.2.5 Describe hand movements during oxyacetylene welding.

E11.2.6 Identify a satisfactory oxyacetylene weld.

E11.2.7 List a shut-down procedure for oxyacetylene welding.

E11.2.8 Describe use of an oxyacetylene cutting torch.

E11.2.9 List various joints used with welding and brazing metals.

CRITERION-REFERENCED MEASURE

C11.2 Oxyacetylene welder used to complete three exercises, and an acceptable rating achieved on instructor-prepared checksheet. All safety precautions observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Determine the three exercises that each student will complete. Prepare instruction sheets or plan sheets for each exercise (E11.2.1-E11.2.9).

2. Have students identify oxyacetylene welding equipment and supplies by placing a name tag on the corresponding part or supply (E11.2.1).

3. Review safety precautions to be followed while using oxyacetylene welding equipment (E11.2.2).

4. Demonstrate the correct start-up, operation, and shut-down procedures to be used for oxyacetylene welding equipment (E11.2.3-E11.2.9).

SELECTED TOOLS AND MATERIALS

Handouts: Instructor-prepared checksheet
Metal
Oxyacetylene welding equipment
Oxyacetylene welding supplies
Safety equipment
Name tags
Instruction or plan sheets

SELECTED AUDIOVISUAL MATERIALS

Films: Welding - Oxy-Acetylene Welding and Cutting - Braze Welding (05919). Audiovisual Services.
Welding - Oxy-Acetylene Welding and Cutting - Flame Cutting (13106). Audiovisual Services.
Oxyacetylene Welding Safety, Parts 1 and 2. Abraxas.

Filmstrips: Welding Explained: Oxyacetylene Non-Fusion Series. Bergwall.
Titles: (1) Basic Nomenclature (2) Preparing the Unit for Welding (3) Lighting and Adjusting the Welding Flame (4) Basic Application (5) Varying Applications.
Welding Explained: Oxyacetylene Fusion Series. Bergwall.
Titles: (1) Basic Nomenclature (2) Preparing the Unit for Welding (3) Lighting and Adjusting the Welding Flame (4) Fusion Welding - Basic Application (5) Fusion Welding - Varying Applications.

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

11. WELDING METAL

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

11.3 Use an electric arc welder

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

11.3

PERFORMANCE OBJECTIVE

P11.3 Given arc welding equipment, supplies, safety equipment, and metal, use an electric arc welder to complete three exercises assigned by the instructor. Each exercise must receive an acceptable rating on an instructor-prepared checksheet. All safety procedures must be observed.

SELECTED ENABLING OBJECTIVES

E11.3.1 Identify arc welding equipment and supplies.

E11.3.2 Describe safety precautions and safety equipment for arc welding.

E11.3.3 Explain the five basic welding joints (butt, tee, edge, lap, and corner) and the four basic welding positions (flat, horizontal, vertical, and overhead).

E11.3.4 Explain the electrode numbering system and the procedure for the selection of an electrode for a particular situation.

E11.3.5 Demonstrate the procedure for starting, maintaining, and stopping a welding bead.

E11.3.6 Describe hand movements during electric arc welding.

E11.3.7 Identify examples of proper welds (correct electrode, current, arc length).

CRITERION-REFERENCED MEASURE

C11.3 Electric arc welder used to complete three exercises, and an acceptable rating achieved on instructor-prepared checksheet. All safety procedures observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students identify electric arc welding equipment and supplies by placing a name tag on the corresponding part or supply (E11.3.1).

2. Review safety precautions to be followed while using electric arc welding equipment (E11.3.2).

3. Demonstrate the correct start-up, operation, and shut-down procedures to be used for electric arc welding equipment (E11.3.3-E11.3.7).

4. Show filmstrips on electric arc welding (E11.3.1-E11.3.7).

5. Have students complete at least three exercises that require using electric arc welding equipment. Evaluate using an instructor-prepared checksheet (E11.3.1-E11.3.7).

SELECTED TOOLS AND MATERIALS

Electric arc welding equipment
Electric arc welding supplies
Handout: Instructor-prepared checksheet
Metal
Safety equipment

SELECTED AUDIOVISUAL MATERIALS

Films: Arc Welding (26812). Audiovisual Services.
Welding - Flat and Horizontal Welding (08610). Audiovisual Services.

Filmstrips: Arc Welding Safety. Abraxas.
Electric Arc Welding Explained Series. Bergwall. Titles: (1) Introduction to AC Arc Welding (2) Protective Devices and Clothing (3) Striking the Arc (4) Running the Bead (5) Weaving a Bead (6) Arc Welding in the Flat Position (7) Arc Welding in the Horizontal Position (8) Arc Welding in the Vertical Position (9) Arc Welding in the Overhead Position.

SELECTED REFERENCES

The Book of Tests: Safety Tests for Welding. Abraxes.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

CONTENT/CONCEPT

12. USING MACHINE TOOLS

TASKS/COMPETENCIES

12.1 Use pedestal grinder

12.2 Turn metal with metal lathe

12.3 Operate drill press

12.4 Use milling machine

12.5 Use stock cutoff machines

12.6 Identify computer numerically controlled (CNC) machine tools

12.7 Identify electrical discharge, chemical, or other nontraditional machining processes

Application

CONTENT/CONCEPT

12. USING MACHINE TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

12.1 Use pedestal grinder

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

12.1

PERFORMANCE OBJECTIVE

P12.1 Given a pedestal grinder, wheel dresser, machinist's square, bevel protractor, and safety equipment, use the pedestal grinder for various sharpening or grinding operations. A tool provided by the instructor must be sharpened to the specified angle. All safety precautions must be observed.

SELECTED ENABLING OBJECTIVES

E12.1.1 Identify the parts of a pedestal grinder and the various types of grinding wheels.

E12.1.2 Inspect the grinding wheels, guards, and tool rest.

E12.1.3 Dress and true the grinding wheel.

E12.1.4 Sharpen various tools on the pedestal grinder.

CRITERION-REFERENCED MEASURE

C12.1 Pedestal grinder used to sharpen a tool to the specified angle. All safety precautions observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students prepare written labels for each component of a pedestal grinder (E12.1.1).

2. Demonstrate how to inspect the grinding wheels, guards, and tool rests and perform needed adjustments (E12.1.2).

3. Demonstrate and have students dress and true the grinding wheel (E12.1.3).

4. Demonstrate the procedures for sharpening various cutting tools on the pedestal grinder (E12.1.4).

SELECTED TOOLS AND MATERIALS

Bevel protractor
Cutting tools (chisels, plane irons)
Goggles
Grinding wheels
Machinist's square
Pedestal grinder
Wheel dresser

SELECTED AUDIOVISUAL MATERIALS

Filmstrip: The Grinding Machine Series. Bergwall. Titles: (1) Basic Parts and Operation (2) Setting Up the Machine (3) The Grinding Operation.

SELECTED REFERENCES

The Book of Tests: Safety Tests for Welding. Abraxas.
Machine Tool Practices. Richard R. Kibbe, and others.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

12. USING MACHINE TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

12.2 Turn metal with metal lathe

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

12.2

PERFORMANCE OBJECTIVE

P12.2 Given a metal lathe and accessories, metal, safety goggles, and procedure sheets, turn metal with metal lathe. Students must follow directions on the procedure sheets and receive acceptable ratings on an instructor-prepared checksheet. All safety procedures must be observed.

SELECTED ENABLING OBJECTIVES

E12.2.1 Identify the most important parts and accessories for a lathe.

E12.2.2 Describe safe practices and precautions for lathe work.

E12.2.3 Explain how work is held and rotated between headstock and tailstock for various machining operations.

E12.2.4 Describe use of cutting tools and toolholders for the metal lathe.

E12.2.5 Explain how to change speeds on a lathe and the reasons for doing so.

E12.2.6 List various machining operations that may be performed on the metal lathe.

E12.2.7 Identify measuring tools used with lathe work.

E12.2.8 Identify lubricants used with the metal lathe.

CRITERION-REFERENCED MEASURE

C12.2 Metal turned with a metal lathe according to directions on procedure sheets. All items on instructor-prepared checksheet rated acceptable, and all safety procedures observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students identify key parts and accessories for a metal lathe (E12.2.1).

2. Have students compile a list of safety practices and precautions that pertain to lathe work (E12.2.2).

3. Demonstrate how metal stock is positioned and held for lathe operations (E12.2.3).

4. Prepare procedure sheets describing operations that the instructor will assign to students. Demonstrate how these operations are completed (E12.2.3-E12.2.8).

SELECTED TOOLS AND MATERIALS

Handouts: Instructor-prepared checksheet
Metal lathe procedure sheets
Metal
Metal lathe and accessories
Safety goggles

SELECTED AUDIOVISUAL MATERIALS

Filmstrips: Lathe Cutting Tools Explained Series. Bergwall. Titles: (1) High Speed Steel Tool Bits (2) Grinding High Speed Steel Tool Bits (3) Tool Holders and Carbide Tools.
The Lathe Explained Series. Bergwall. Titles: (1) Its Basic Parts (2) Setting Up Work (3) Its Accessories (4) Work Operations on 3 and 4 Jaw Chucks (5) Three Ways to a Taper (6) Cutting to a thread.
Metal Shop Safety Series. Bergwall. Title: (3) Working with a Metal Lathe.

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

12. USING MACHINE TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

12.3 Operate drill press

COURSE

Metals Technology I (8439)

12.3

PERFORMANCE OBJECTIVE

P12.3 Given resource materials, a designated project, a drill press, various drills, metal, and the necessary safety equipment, operate the drill press in accordance with instructor's demonstration. The correct boring tool must be selected for designated project, and all operations must conform to safety standards.

SELECTED ENABLING OBJECTIVES

E12.3.1 Explain uses of a drill press, identify the parts of a drill press, and state operation and/or function of the depth stop, quill lock, quill, chuck, feed handle, column table, table locking clamp, and base.

E12.3.2 List and describe safety rules for operation of a drill press.

E12.3.3 Name the types of drills or attachments used in a drill press and describe their functions. Include (a) twist drill, (b) straight-fluted drill, (c) spade drill, (d) drill drift, (e) drill sleeves, (f) drill chuck and chuck key, (g) drill gauge, (h) reamer (i) countersink, (j) counterbore, and (k) tapping attachment.

CRITERION-REFERENCED MEASURE

C12.3 Drill press operated in accordance with instructor's demonstration. Correct boring tool selected for designated project, and all operations conform to safety standards.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Display a drill press, boring tools, and drill press attachments. Discuss uses of a drill press, identify the parts, and explain the operation and function of the drill press controls (E12.3.1).
2. Have students view safety film on the safe operation of the drill press and demonstrate how to apply safety rules (E12.3.2).
3. Display and identify drill press attachments and boring tools used on the drill press. Discuss uses for each tool or attachment (E12.3.3).
4. Have students select the proper boring tools or drill press attachment for a designated project (E12.3.3).
5. Demonstrate how to operate a drill press, using a variety of boring tools and drill press attachments. Supervise student practice in the safe operation of a drill press (E12.3.1-E12.3.3).

SELECTED TOOLS AND MATERIALS

Counterbore
Countersink
Drill chuck and key
Drill drift
Drill gauge
Drill press
Drill press vise
Drill sleeves
Goggles
Metal
Reamer
Spade drill
Straight-fluted twist drill
Tapping attachment
Twist drill

SELECTED AUDIOVISUAL MATERIALS

Films: Drill Press (81009). Audiovisual Services.
Drill Press - Basic Holding Techniques (79604). Audiovisual Services.

Filmstrips: The Drill Press Explained Series. Bergwall. Titles: (1) Basic Parts (2) Work Holding Methods (3) Work Layout (4) Drilling the Work.

SELECTED REFERENCES

The Book of Tests: Safety Test for Welding. Abraxas.
Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

12. USING MACHINE TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

12.4 Use milling machine

COURSE

Metals Technology II (8442)

12.4

PERFORMANCE OBJECTIVE

P12.4 Given a milling machine and accessories, safety goggles, and procedure sheets, use the milling machine to complete exercises assigned by the instructor. All exercise must receive an acceptable rating on an instructor-prepared checksheet. All safety precautions must be observed.

SELECTED ENABLING OBJECTIVES

E12.4.1 Identify the most important parts and accessories for the milling machine (horizontal or vertical).

E12.4.2 Describe safe practices and precautions for mill work.

E12.4.3 Identify workpiece-holding devices and accessories, milling cutter, and cutting fluids.

E12.4.4 Explain how to change cutting speeds and feeds on the machine.

E12.4.5 List various machining operations that may be performed on the milling machine.

CRITERION-REFERENCED MEASURE

C12.4 Milling machine used correctly in completing exercises. All items on instructor-prepared checksheet rated acceptable. All safety precautions observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students identify key parts and accessories for a milling machine (E12.4.1).

2. Have students compile a list of safety practices and precautions that pertain to milling work (E12.4.2).

3. Demonstrate how metal stock is positioned and held for milling operations (E12.4.3).

4. Prepare procedure sheets describing work that the instructor will assign to students. Demonstrate how this work is to be completed (E12.4.3-E12.4.5).

SELECTED TOOLS AND MATERIALS

Handouts: Instructor-prepared checksheet
Milling machine procedure sheets
Metal
Milling machine and accessories
Safety goggles

SELECTED AUDIOVISUAL MATERIALS

Filmstrips: Metal Shop Safety Series. Bergwall. Title: Working With A Vertical Milling Machine
Milling Machine Explained Series. Bergwall. Titles: (1) Its Basic Parts (2) Setting Up (3) Accessories and Work Samples (4) The Universal Milling Attachment (5) The Dividing Head (6) Work on the Dividing Head.
The Vertical Milling Machine Explained Series. Bergwall. Titles: (1) Basic Parts (2) Setting Up (3) Accessories and Work Samples (4) The Rotary Table Explained (5) Additional Accessories (6) The Digital Readout System.

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

12. USING MACHINE TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

12.5 Use stock cutoff machines

COURSE

Metals Technology II (8439)

12.5

PERFORMANCE OBJECTIVE

P12.5 Given a stock cutoff machine, metal, safety goggles, and procedure sheets, use a stock cutoff machine. All cuts must be made following instructor directions and meet specifications outlined on the respective procedure sheet. All safety procedures must be observed.

SELECTED ENABLING OBJECTIVES

E12.5.1 Identify stock cutoff machines by type, size, nomenclature, and range of work.

E12.5.2 Describe safe practices and precautions for a stock cutoff machine.

E12.5.3 Identify types of work holding devices and support devices for a stock cutoff machine.

E12.5.4 Identify, select, mount, and maintain saw blades.

E12.5.5 Explain how to change speeds, feeds, and apply lubricating fluids for stock cutoff machines.

E12.5.6 Determine how to position work in order to cut stock to finish dimensions.

CRITERION-REFERENCED MEASURE

C12.5 Stock cutoff machines used in accordance with instructor's directions. Cuts made meet specifications outlined. All safety procedures observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students identify key parts and accessories for a stock cutoff machine (E12.5.1).

2. Have students compile a list of safety practices and precautions that pertain to stock cutoff machines (E12.5.2).

3. Demonstrate how metal stock is positioned and held for each stock cutoff machine (E12.5.3).

4. Prepare procedure sheets describing work that the instructor will assign to students. Demonstrate how this work is to be completed (E12.5.3-E12.5.6).

SELECTED TOOLS AND MATERIALS

Handout: Instructor-prepared stock cutoff procedure sheets
Measuring tools
Metal
Safety goggles
Stock cutoff machine (power hacksaw, horizontal band saw, cold saw, abrasive cutoff saw)

SELECTED AUDIOVISUAL MATERIALS

Film: Power Hacksaw and Band Saw (55709). Audiovisual Services.

SELECTED REFERENCES

The Book of Tests: Safety Tests for Welding. Abraxas
Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

12. USING MACHINE TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

12.6 Identify computer numerically controlled (CNC) machine tools

COURSE

Metals Technology II (8442)

12.6

PERFORMANCE OBJECTIVE

P12.6 Given reference materials, identify CNC machine tools operations with 85% accuracy on an instructor-prepared quiz.

SELECTED ENABLING OBJECTIVES

E12.6.1 Describe the Cartesian coordinate system (X, Y, Z).

E12.6.2 Differentiate the point-to-point and continuous path numerical control systems.

E12.6.3 Outline the steps in the production of a part using computer numerically controlled machine tools.

E12.6.4 Relate this process to the introduction of computers in the metal-working field.

CRITERION-REFERENCED MEASURE

C12.6 Computer numerically controlled CNC machine tools operations identified on instructor-prepared quiz with 85% accuracy.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students examine a numerically controlled machine and describe the differences between this machine and a manually-controlled machine (E12.6.1).

2. Have students examine resource materials that have information about the numerically controlled machines (E12.6.1-E12.6.4).

3. Plan a field trip or secure audiovisuals describing computer numerically controlled (CNC) machine tools and have students observe the usage of these machines (E12.6.1-E12.6.4).

SELECTED TOOLS AND MATERIALS

Handout: Instructor-prepared quiz

SELECTED AUDIOVISUAL MATERIALS

Filmstrips: Numerical Control Explained: Two-Axis Milling Machine Series. Bergwall. Titles: (1) Introduction to Operation (2) Preparing the Program (3) Preparing the Tape (4) Programing Curves and Angles.

SELECTED REFERENCES

Machine Tool Practices. Richard R. Kibbe, and others.
Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

12. USING MACHINE TOOLS

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

12.7 Identify electrical discharge, chemical, or other nontraditional machining processes

COURSE

Metals Technology II (8442)

12.7

PERFORMANCE OBJECTIVE

P12.7 Given reference materials and classroom instruction, identify electrical discharge, chemical, or other nontraditional machining processes on an instructor-prepared quiz with 85% accuracy.

SELECTED ENABLING OBJECTIVES

E12.7.1 List forms of nontraditional machining processes.

E12.7.2 List types of EDM machines and their usage.

E12.7.3 Explain the process used for electrochemical machining.

E12.7.4 Explain chemical milling and chemical blanking techniques.

E12.7.5 Explain the operation of a laser and how it can be used in metal-working.

CRITERION-REFERENCED MEASURE

C12.7 Electrical discharge, chemical, or other nontraditional machining processes identified on instructor-prepared quiz with 85% accuracy.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students examine resource materials that have information about nontraditional machining processes (E12.7.1,E12.7.2).

2. Have students survey local metalworking businesses to determine if any nontraditional machining processes are being used (E12.7.1-E12.7.5).

SELECTED TOOLS AND MATERIALS

Handout: Instructor-prepared quiz

SELECTED AUDIOVISUAL MATERIALS

None identified

SELECTED REFERENCES

Machining Fundamentals. John R. Walker.
Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

CONTENT/CONCEPT

13. FINISHING METAL

TASKS/COMPETENCIES

13.1 Prepare metals for finishing

13.2 Apply finish to metal

13.3 Buff metal

Application

CONTENT/CONCEPT

13. FINISHING METAL

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

13.1 Prepare metals for finishing

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

13.1

PERFORMANCE OBJECTIVE

P13.1 Given samples of metal, wire brush, solvents, etching acid, goggles, gloves, and respirator, prepare metals for finishing. The surface must be clear of oil, rust, or moisture, and all safety precautions must be observed.

SELECTED ENABLING OBJECTIVES

E13.1.1 Identify materials used to prepare metals for finishing.

E13.1.2 State a procedure to be followed when applying solvents or etching acids to metal.

E13.1.3 Outline how scale, rust, grease, or oil should be removed from metal surfaces.

CRITERION-REFERENCED MEASURE

C13.1 Metals prepared for finishing with all safety precautions observed. Surface is clear of all oil, rust, or moisture.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Gather samples of metal that require different preparations for finishing. Have students determine materials that could be used to prepare metals for finishing (E13.1.1).

2. Demonstrate the application of solvents or etching acids to metal. Note especially the safety precautions to be followed (E13.1.2).

3. Have students remove materials such as scale, rust, grease, or oil from metal surfaces (E13.1.3).

SELECTED TOOLS AND MATERIALS

Etching acid (Note: Use extreme caution)
Gloves
Goggles
Metal samples
Respirator
Solvents
Wire brush

SELECTED AUDIOVISUAL MATERIALS

None identified

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

13. FINISHING METAL

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

13.2 Apply finish to metal

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

13.2

PERFORMANCE OBJECTIVE

P13.2 Given prepared samples of metal and a metal finish, apply the finish to metal surfaces. All items on an instructor-prepared checksheet must be rated acceptable. All safety precautions must be observed.

SELECTED ENABLING OBJECTIVES

E13.2.1 Identify various finishes that are applied to metal.

E13.2.2 Explain safety hazards associated with the application of metal finishes.

E13.2.3 Operate equipment needed to apply finish.

E13.2.4 Describe procedures for appling finish to metal.

CRITERION-REFERENCED MEASURE

C13.2 Finish applied to metal surface with all items on instructor's checksheet rated acceptable. All safety precautions observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have students use the samples of metal prepared for finishing in task 13.1. For each sample, have the student determine an appropriate finish to be applied (E13.2.1).

2. Have students examine metal surfaces at home and at school and compile a list of finishes observed (E13.2.1).

3. Demonstrate the application of finishes to metal and have students follow these procedures (E13.2.1-E13.2.4).

4. Point out the safety hazards associated with this task (E13.2.2).

SELECTED TOOLS AND MATERIALS

Application equipment (brush, spray gun)
Enamel
Handout: Instructor-prepared checksheet
Lacquer
Paint
Solutions for forming metallic oxides
Metal samples

SELECTED AUDIOVISUAL MATERIALS

None identified

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

Application

CONTENT/CONCEPT

13. FINISHING METAL

PROGRAM

INDUSTRIAL ARTS (21.0199)

TASK/COMPETENCY

13.3 Buff Metal

COURSE

Metals Technology I (8439)
Metals Technology II (8442)

13.3

PERFORMANCE OBJECTIVE

P13.3 Given samples of metal, buffing machine or grinder, buffing wheel, buffing compound, goggles, and respirator, buff metal following instructions and demonstration provided by the instructor. Surface must be free of scratches. All safety precautions must be observed.

SELECTED ENABLING OBJECTIVES

E13.3.1 Identify materials used to buff metal.

E13.3.2 Explain the purpose and uses of buffing compounds.

E13.3.3 Describe procedures for buffing metal.

E13.3.4 Identify safety rules to be followed while buffing metal.

CRITERION-REFERENCED MEASURE

C13.3 Metal buffed in accordance with teacher's instructions and demonstration. Surface free of scratches. All safety precautions observed.

SELECTED INSTRUCTIONAL ACTIVITIES

1. Assemble materials and metal samples that will be used for buffing. Have students identify materials (E13.3.1).

2. Have students research proper usage of various buffing compounds and report orally to the class (E13.3.2).

3. Demonstrate procedures to be followed in buffing metal and have students perform the task (E13.3.1-E13.3.4).

SELECTED TOOLS AND MATERIALS

Buffing compounds
Buffing machine or grinder
Buffing wheel
Goggles
Metal samples
Respirator

SELECTED AUDIOVISUAL MATERIALS

None identified

SELECTED REFERENCES

Metalwork Technology and Practice, 7th ed. Victor E. Repp, and others.

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APPENDIX

AUDIOVISUAL AIDS

I. Films, filmstrips, and audiovisual kits, slides, or videotapes available from Virginia Department of Education.

A. Available from Audiovisual Services, State Department of Education, P.O. Box 6Q, Richmond, Virginia 23216.

ABC of Hand Tools - Part I	(20810)
ABC of Hand Tools - Part II	(20910)
Apprenticeship Training	(05305)
Arc Welding	(26812)
Art of Communication: Aids to Speaking	(28808)
Art of Communication: How to Conduct a Meeting	(21908)
Careers in Machine Trades	(81012)
Cast Iron - The Biography of a Metal	(25312)
Copper	(12012)
Drafting - Drawing and Planning	(42709)
Drill Press	(81009)
Drill Press - Basic Holding Techniques	(79604)
Forge and Ornamental Iron	(82609)
Hand Tools for Metal Work	(48912)
I. A. for the 70's, Program 2 - Its Better to be Safe than Sorry	(27290)
I. A. for the 70's, Program 4 - Let's Make Money for Everyone	(30290)
I. A. for the 70's, Program 5 - You've Got to be Organized	(30390)
I. A. for the 70's, Program 6 - If We Do It Like This	(30490)
I. A. for the 70's, Program 7 - Why Didn't We Think of That	(30590)
I. A. for the 70's, Program 13 - From Beginning to End	(30890)
I. A. for the 70's, Program 14 - From Here It Goes To	(30990)
I. A. for the 70's, Program 26 - Will It Work--Will It Sell	(29790)
Machine Operation - Sheet Metal	(82909)
Metal Work - Hand Tools - Layout	(41809)
Playing It Safe With Power Tools	(06010)
Power Hacksaw and Band Saw	(55709)
Precision Measuring - Combination Square	(55509)
Precision Measuring - Depth Gauge and Inside Micrometer	(36610)
Precision Measuring - Micrometer	(55409)
Precision Measuring - Vernier Calipers	(36010)
Safety in the Shop - Basic Practices	(37310)
Safety in the Shop - Hand Tools	(37210)
Safety in the Shop - Power Tools	(37010)
School Shop Safety	(20609)
Soft Soldering	(62304)
Soldering and Brazing Copper Tubing	(71201)
Steel and America	(90312)

The Toolmaker's Art	(54910)
Tungsten	(47608)
We'll See Tomorrow	(52006)
Welding - Flat and Horizontal Welding	(08610)
Welding - Fusion Welding of Light Gauge Steel	(13006)
Welding - Oxy-Aceytlene Welding and Cutting - Braze Welding	(05910)
Welding - Oxy-Acetylene Welding and Cutting - Flame Cutting	(13106)

B. Available from Industrial Arts Education Service, State Department of Education, P. O. Box 6Q, Richmond, Virginia 23216.

In-Class AIASA Management
Move With Tomorrow
Organizing the Industrial Arts Student Organization

II. Films, filmstrips, audiovisual kits, slides, or videotapes available from other suppliers.

A. Abraxas Films, P. O. Box 146, Eugene, Oregon 97440.

Arc Welding Safety
Introduction to Machine/Metal Shop Safety
Oxy-acetylene Welding Safety, Parts 1 & 2

B. Bergwall Productions, Inc., P. O. Box 238, Garden City, New York 11530-1238.

Bench Metalwork Series. Titles: (1) Introduction - Tools and Processes (2) Cutting Processes (3) Files and Filing Procedures (4) Bending and Shaping (5) Drilling, Reaming and Threading (6) Peening, Finishing and Assembly (7) The Forging Process

The Drill Press Explained Series. Titles: (1) Basic Parts (2) Work Holding Methods (3) Work Layout (4) Drilling the Work

Electric Arc Welding Explained Series. Titles: (1) Introduction to AC Arc Welding (2) Protective Devices and Clothing (3) Striking the Arc (4) Running a Bead (5) Weaving a Bead (6) Arc Welding in the Flat Position (7) Arc Welding in the Horizontal Position (8) Arc Welding in the Vertical Position (9) Arc Welding in the Overhead Position

Foundry Work Series. Titles: (1) Introduction and Overview (2) Tools and Equipment (3) Preparing and Pouring a One Piece Casting - Part One (4) Preparing and Pouring a One Piece Casting - Part Two (5) Preparing a Split Pattern Casting (6) Foundry (Match Plate Pattern)

The Grinding Machine Series. Titles: (1) Basic Parts and Operation (2) Setting Up the Machine (3) The Grinding Operation

Lathe Cutting Tools Explained Series. Titles: (1) The Vernier Caliper (2) The Outside Micrometer (3) Inside Micrometers (4) Depth Gauges (5) Dial Indicators (6) Protractors and "JO" Blocks

The Lathe Explained Series. Titles: (1) Its Basic Parts (2) Setting Up Work (3) Its Accessories (4) Work Operations on 3 and 4 Jaw Chucks (5) Three Ways to a Taper (6) Cutting a Thread

Measuring Tools Explained Series. Titles: (1) The Vernier Caliper (2) The Outside Micrometer (3) Inside Micrometer (4) Depth Gauge (5) Dial Indicators (6) Protractors and "JO" Blocks

Metric Measuring Tools Explained Series. Titles: (1) The Metric Vernier Caliper (2) The Metric Outside Micrometer (3) The Metric Inside Micrometer (4) The Metric Micrometer Depth Guage

Metal Shop Safety Series. Titles: (1) Protective Clothing and Good Hand Tool Practices (2) Working With Power Tools and Machines (3) Working with a Metal Lathe (4) Working with a Vertical Milling Machine

Milling Machine Explained Series. Titles: (1) Its Basic Parts (2) Setting Up (3) Accessories and Work Samples (4) The Universal Milling Attachment (5) Dividing Head (6) Work on the Dividing Head

Numerical Control Explained: Two-Axis Milling Machine Series. Titles: (1) Introduction to Operation (2) Preparing the Program (3) Preparing the Tape (4) Programing Curves and Angles

Sheet Metal Fabricating Machinery Explained. Titles: (1) The Foot Operated Shear (2) The Turret Punch Press (3) The Tab Notcher (4) The Hand Operated Shear (5) The Single Station Punch (6) The Hand Operated Press Brake (7) The Finger Brake (8) The Hand Operated Bender

Sheet Metalwork Series. Titles: (1) Introduction and Overview (2) Straight Line Pattern Development (3) Parallel and Radial Line Pattern Development (4) Cutting Methods (5) Drilling, Forming and Bending - Part One (6) Forming and Bending - Part Two (7) Assembly and Fastening

The Vertical Milling Machine Explained Series. Titles: (1) Basic Parts (2) Setting Up (3) Accessories and Work Samples (4) The Rotary Table Explained (5) Additional Accessories (6) The Digital Readout System

Welding Explained: Oxy-acetylene Fusion Series. Titles: (1) Basic Nomenclature (2) Preparing the Unit for Welding (3) Lighting and Adjusting the Flame (4) Fusion Welding - Basic Applications

Welding Explained: Oxy-acetylene Non-Fusion Series. Titles: (1) Basic Nomenclature (2) Preparing the Unit for Welding (3) Lighting and Adjusting the Welding Flame (4) Basic Applications (5) Varying Applications

C. Career Aids, Inc., 8950 Lurline Avenue, Department S567, Chatsworth, California 91311

Metalworking Series. Titles: (1) Overview (2) Machinist (3) Sheet Metal Worker (4) Welder (5) Electroplater (6) Foundry Worker

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